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ANACONDA—HAMILTON 161 KV TRANSMISSION LINE

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DRAFT ENVIRONMENTAL IMPACT STATEMENT ON

THE PROPOSED MONTANA POWER COMPANY ANACONDA-HAMILTON 161 kV TRANSMISSION LINE

ENERGY PLANNING DIVISION
ALBERT C. TSAO, ADMINISTRATOR
DEPARTMENT OF NATURAL RESOURCES & CONSERVATION
GARY J. WICKS, DIRECTOR

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CHAPTER ONE

INTRODUCTION

Prior to the construction and operation of certain utility facilities within the State of Montana, an application must be made to the Department of Natural Resources and Conservation (Department or DNRC) for a Certificate of Environmental Compatibility and Public Need. Applications made before April 21, 1975, were filed in conformance with the Montana Utility Siting Act of 1973 (effective April 21, 1975, the Act was revised and renamed the Montana Major Facility Siting Act). Facilities which require a Certificate were identified in the Utility Siting Act as follows:

(1) any energy-generating and conversion plant and associated facilities designed for, or capable of:

  (a) generating at fifty (50) megawatts of electricity or more

  (b) Producing one hundred million (100,000,000) cubic feet of gas per day or more

  (c) producing fifty thousand (50,000) barrels of liquid hydrocarbon products per day or more

  (d) enriching uranium minerals

(2) an electric transmission line and associated facilities of a design capacity of thirty-four and one-half (34.5) kilovolts or more, with the following exceptions:

  (a) a transmission line and associated facilities with a design capacity of sixty-nine (69) kilovolts or less constructed above ground for a distance of ten (10) miles or less shall not be considered a utility facility

  (b) a transmission line and associated facilities with a design capacity of one hundred sixty-one (161) kilovolts or less constructed underground for a distance of five (5) miles or less shall not be considered a utility facility

(3) a gas or liquid transmission line and associated facilities designed for, or capable of, transporting gas or liquid hydrocarbon products from a gasification or liquefaction facility of the size indicated in (1) (b) and (1) (c) above

(4) any use of geothermal resources, including the use of underground space in existence or to be created, for the creation, use or conversion of energy

An application for the construction of a facility as specified above shall be made two years before the expected commencement of construction. The Department is then responsible for preparation of an environmental impact statement. Within six hundred (600) days following receipt of an application, the Department recommends to the Board of Natural Resources and Conservation whether the proposed facility should be certified. The final decision rests with the Board.

Within this chapter, general information can be found relating to the application filed for the Anaconda-Hamilton 161 kV transmission line project.

1.1. Date of Filing Application

Applicant, General Content

In accordance with the Montana Utility Siting Act, an application was filed by the Montana Power Company (MPC) with the Department on December 31, 1974, for permission to construct a 161 kilovolt electric transmission line facility between Anaconda and Hamilton. The proposed facility would be located in Deer Lodge, Granite, and Ravalli Counties, Montana, and on the Deer Lodge and Bitterroot National Forests.

The proposed facility would consist of 65 miles of 161 kV electric transmission line (see map entitled "Applicant's Requested Routes"). It would proceed from the Mill Creek substation located in Section 17, T. 4 N. R. 10 W., in a general westerly direction, to the proposed site for the Hamilton Heights Substation located in Section 13, T. 6 N. R. 20 W. From the Hamilton Heights Substation, a 69 kV circuit would proceed between five and six miles to the existing Hamilton City 69 kV system in the vicinity of Hamilton. The 69 kV circuit would be installed on 5.2 miles of existing structures creating a double circuit 69 kV line. The new 69 kV circuit would be connected to the existing 69 kV "A" line.

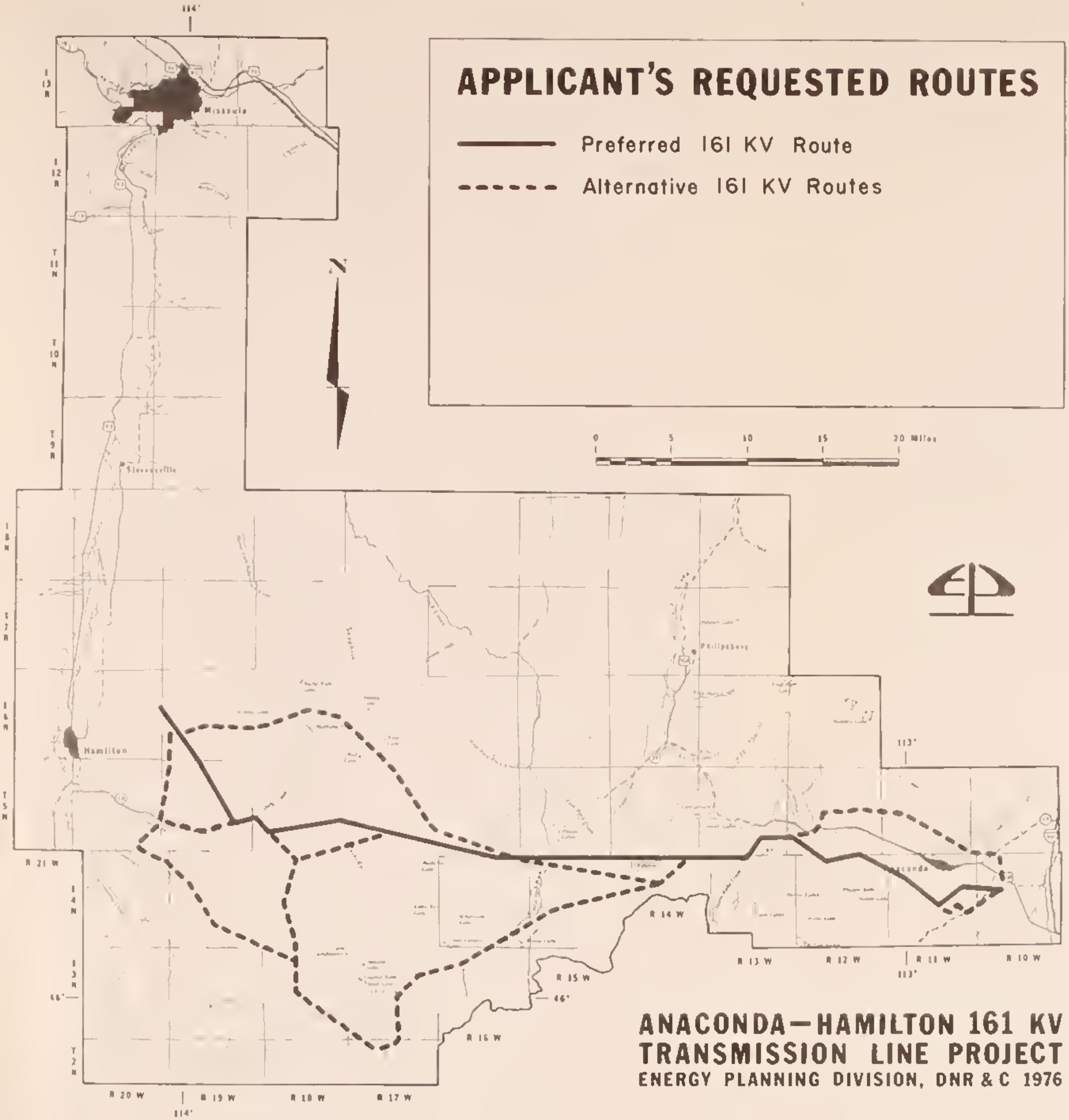
According to the applicant, the proposed 161 kV transmission line ". . . is needed to provide adequate and reliable service to the Bitterroot area and also the city of Missoula, Montana". Four basic alternative plans and technologies were considered by the applicant for serving the electrical loads in the Bitterroot Valley:

PLAN "A"--Build Anaconda-Hamilton 161 kV line in 1976-1977 and second Hamilton Heights-Hamilton 69 kV line in 1977

PLAN "B"--Build second Missoula (Rattlesnake)-Hamilton 161 kV line in 1977

PLAN "C"--Defer second 161 kV line three years by rebuilding Missoula-Hamilton 69 kV "B" line in 1977

PLAN "D"--Rebuild 69 kV "B" line in 1977; install 30 megawatts of combustion turbine generation in 10 megawatts increments in the Hamilton area between 1979 and 1985



APPLICANT'S REQUESTED ROUTES

———	Preferred 161 KV Route
- - - - - -	Alternative 161 KV Routes

ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976

The MPC maintains in Section III-4 of its application, "Summary of Alternate Plans," that because a 161 kV line from Anaconda to Hamilton would provide greater reliability to the Bitterroot Valley and the City of Missoula, and would also meet the long-range needs of the Philipsburg area, it is superior to a second 161 kV line from Missoula to Hamilton. The MPC also states that the Anaconda-Hamilton route is the most advantageous of the four alternatives because it would have less impact upon existing human settlements and future land uses, as it would avoid the residential areas in the City of Missoula. The applicants preferred and alternative transmission corridors are shown on the map entitled "Applicants Requested Routes." The applicant projects that the proposed Anaconda-Hamilton 161 kV line will be sufficient to transmit power to the Bitterroot until 1995.

The remainder of this chapter gives a general overview of the study area's physical and cultural attributes.

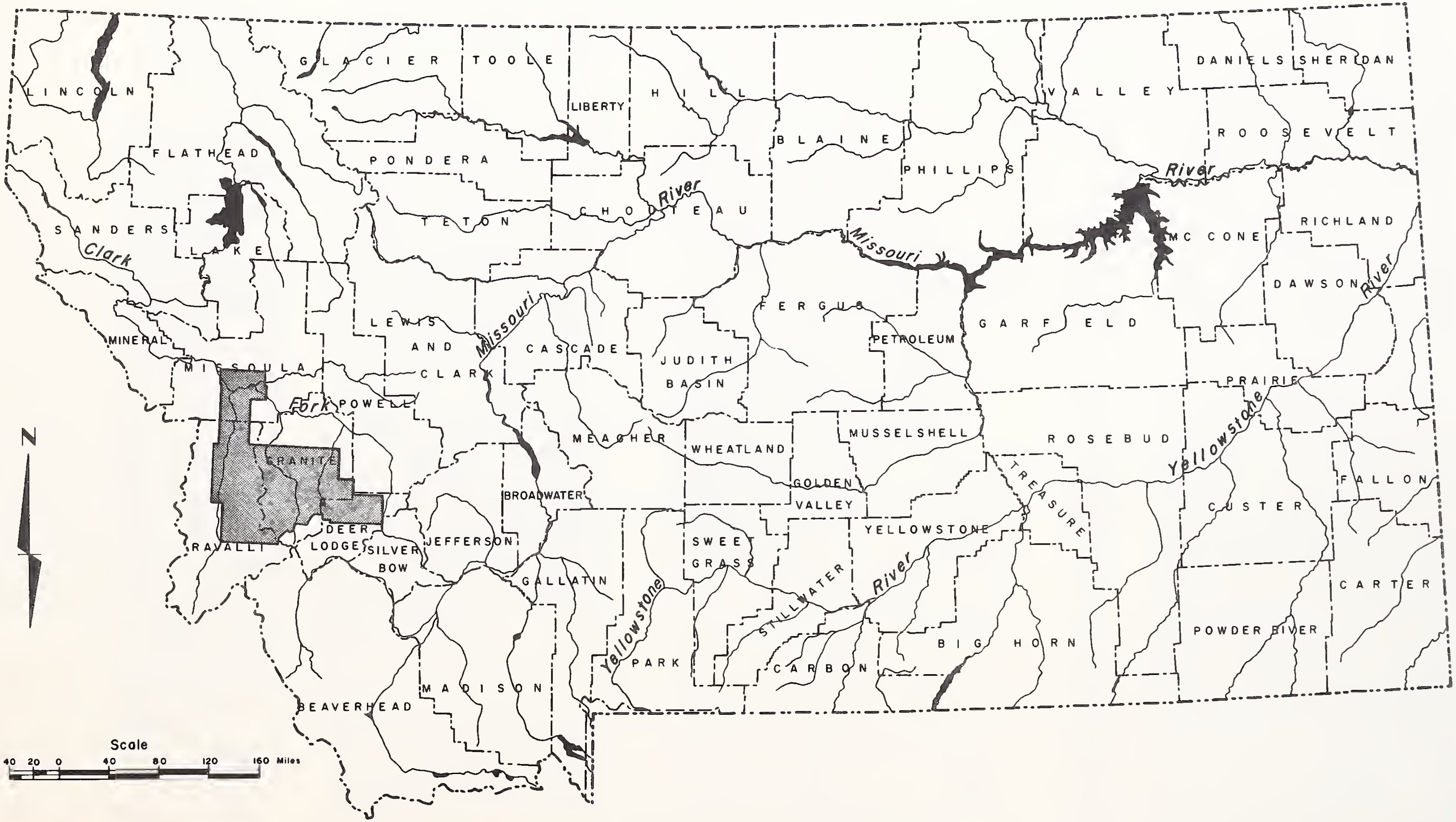
1.2. Overview of the Study Area

A. Physiography and Surface Drainage Patterns

The Anaconda-Hamilton study area is roughly L-shaped and lies near the western edge of Montana, as shown in Figure 1-1. It is located entirely within the Northern Rocky Mountains physiographic province and is drained by the Clark's Fork of the Columbia River and its tributaries. In the following discussion, the major physiographic features of the study area will be described, along with major surface waters and drainage patterns, beginning at the western edge of the study area and progressing eastward (see Slope Map in the back pocket and Relief Map for locations of features mentioned in the following text).

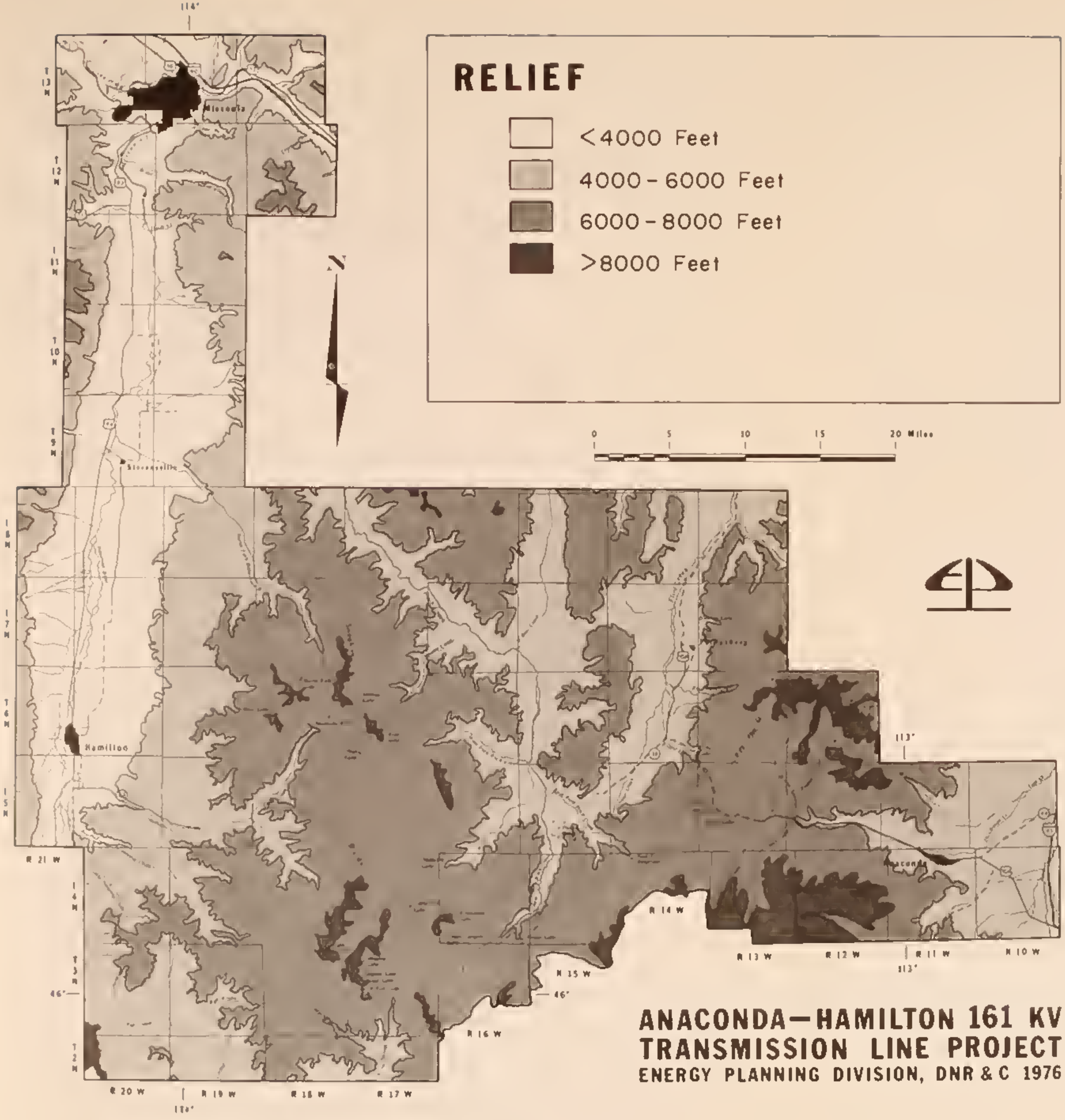
The general physiography of the study area consists of two parallel north-south valleys, the western Bitterroot and the eastern Deer Lodge Valleys. They are separated by a mountainous area consisting of the Sapphire, John Long, Anaconda, and Flint Creek mountain ranges. Two minor valleys, the Rock Creek and Philipsburg Valleys, are also located within this mountainous area. A portion of the Bitterroot Mountains is included along the western boundary of the study area, and small segments of the Mission and Garnet Ranges (separated by the Blackfoot River) are included along the northern boundary. Elevations range from a low of 3,100 feet in the Clark's Fork Valley near the extreme northwest corner of the study area to a high of 10,665 feet on Mt. Haggin in the Anaconda Range.

The east slope of the Bitterroot Mountains, a major mountain uplift forming part of the Montana-Idaho border, occurs along the western boundary of the study area. This mountain range rises abruptly from the adjacent valley at approximately 4,000 feet and attains elevations of over 8,000 feet within the study area. This range is dissected by streams which have carved out nearly parallel west-east gorges, often forming almost vertical cliffs.



ANACONDA — HAMILTON 161 KV STUDY AREA

Figure 1-1



ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976

The Bitterroot Valley, the largest valley in the study area and one of the major river valleys in western Montana, extends in a north-south direction between the Bitterroot and Sapphire Mountain Ranges. A relatively wide, flat valley over most of length, it is characteristic of the broad, basin-like intermontane valleys of the northern Rockies. It varies in width from approximately ten miles near Corvallis to less than three miles north of Lolo, where the river passes through a shallow canyon. The Bitterroot River, which arises in the Bitterroot, Sapphire, and Anaconda Mountains, flows north and joins the Clark's Fork River west of Missoula. Elevations in the valley bottom range from 3,200 feet at the mouth of the Bitterroot to 4,000 feet at Conner.

A small portion of the Clark's Fork River Valley, including the confluence of the Clark's Fork and Blackfoot Rivers, lies in the northern extremity of the study area. This valley is essentially an extension of the Bitterroot Valley; both are similar in width and topography. The Clark's Fork Valley is widest north and west of Missoula, bordered on the north by the Mission and Garnet Ranges and on the south by the Sapphire Range.

The foothills of the Sapphire Mountains rise gradually from the eastern edge of the Bitterroot Valley, much more gradually than do the Bitterroots to the west. These mountains have the character of a dissected plateau, extending roughly along a north-south axis parallel to the Bitterroot Valley. There are no sharp peaks comparable to those of the Bitterroot and Anaconda Ranges; few peaks rise above 8,500 feet. Basal elevations at the edge of the Bitterroot Valley are approximately 4,000 feet. The highest peaks in this range are Dome-Shaped Mountain (8,694 feet) and Mount Emerine (8,687 feet).

Numerous mountain lakes and high, moist basins of low relief (such as Sand Basin, Coyote Meadows, and Frogpond Basin) occur near the Sapphire Divide. Relief is low to moderate throughout most of the range; greatest relief is found in the steep canyons of the major streams which drain the west slope of the range. Of these streams, Skalkaho Creek and the Burnt Fork of the Bitterroot River are major streams draining this area, forming canyons which are relatively steep and which exhibit relief of 2,500 feet or more between the creek bottom and adjacent peaks.

Relief on the east slope of the Sapphire Divide is generally shallower, and major streams do not cut the steep canyons characteristic of those to the west, except near their headwaters. The Ross Fork and Middle Fork of Rock Creek, for example, flow through relatively wide, shallow basins along their middle and lower reaches. Lower Rock Creek, however, a major stream which separates the Sapphire and John Long Mountains near the center of the study area, consists of a flat but very narrow valley bordered by steep, rugged slopes which rise to peaks of 3,000 or more feet above the valley bottom. Likewise, many smaller tributaries to Lower Rock Creek which arise in the Sapphires cut steep and narrow canyons.

North and east of Rock Creek, a portion of the John Long Mountains (sometimes considered part of the Sapphire Range) extends into the study area. These mountains are separated by the wide, shallow, north-south valley of Willow Creek (a tributary to Rock Creek) into two main masses. The western half of the range is relatively high, and of high relief west of Sandstone

Ridge. The major peak, Quigg Peak, rises to 8,498 feet--over 4,000 feet above the nearby Rock Creek Valley. East of Sandstone Ridge the mountains slope gradually to Willow Creek, and areas having slopes greater than 30% are rare.

The eastern segment of the John Long Mountains extends along a north-south axis between Willow Creek and Rock Creek to the west and the Philipsburg Valley to the east. This is a relatively minor mountainous area, and consists of rolling hills with a single ridge, mostly below 7,000 feet in elevation. Relief is moderate to shallow throughout. Elevations are highest at the northern boundary of the study area, where several peaks exceed 7,900 feet. A minor peak of 7,087 feet in elevation is found near the southern end of the range.

East of the John Long Mountains is the Philipsburg Valley, a high, narrow intermountain valley which is essentially continuous with the upper Rock Creek Valley. The valley is roughly 18 miles in length and generally less than 4 miles in breadth. Flint Creek, which originates in Georgetown Lake, flows northward through the valley to join the Clark's Fork River north of the study area. Elevations in the valley floor range from 6,000 feet at the upper end of the valley to 5,000 feet where Flint Creek leaves the valley through a steep, narrow canyon. The divide between the upper Rock Creek Valley and the upper Philipsburg valley is characterized by rolling, moderately dissected hills, mostly under 6,500 feet in elevation.

The Anaconda Range forms part of the southern boundary of the study area. This is the highest of the mountain ranges of the area; it is ruggedly alpine, with many jagged glacier-sculpted peaks over 10,000 feet in elevation. Mount Haggin, at 10,665 feet, is the highest peak in the study area. Many alpine lakes occur in the high, moist glacial cirques. East Fork Reservoir, an impoundment of the East Fork of Rock Creek, is found within the north slope of this range. Below about 8,000 feet, relief is somewhat more moderate; the foothills of this range west of Storm Lake Creek are scarcely more rugged than those of the adjacent east slope of the Sapphires.

The Anaconda Range is separated from the Flint Creek Range to the north by a narrow, saddle-like pass, about 6,400 feet in elevation at its highest point near Silver Lake. The town of Anaconda is located at the eastern end of the Anaconda-Flint Creek pass. Warm Springs Creek, which originates high in the Flint Creek range, flows eastward through this pass to join the Upper Clark's Fork River just east of the study area. Georgetown and Silver Lakes, the first and second largest bodies of water in the study area, are man-made impoundments which fill the shallow basins near the top of this pass. Flint Creek leaves Georgetown Lake through a short, steep, and dramatic canyon.

The Flint Creek Range, while not as high as the Anaconda Range, is nevertheless characterized by steep, glaciated peaks and high relief. Several summits above 9,000 feet are found within the study area. Like the Anaconda Range, these mountains are dotted with numerous alpine lakes, and are drained by mountain streams which carve steep canyons through the foothills.

The easternmost extremity of the study area includes a small portion of the upper Deer Lodge Valley. This is another typically wide and flat intermountain valley, and roughly parallels the Bitterroot Valley. Elevations on the Valley floor range from a low of 4,800 feet near the Clark's Fork River to 5,200 feet at the base of the Anaconda and Flint Creek Ranges. Tailings and settling ponds from the Anaconda Company's Washoe smelter cover relatively large areas within this valley (see map entitled "Existing Land Use" in the back pocket of this publication).

B. Climate

The climate throughout the study area varies in response to the physiographic variation discussed above. Relatively great climatic differences are possible over short distances due to the combined effects of differences in elevation and slope exposure. As elevation increases from the valley floors to mountain peaks, wind speeds and total precipitation will generally increase, while mean temperature and temperature range will generally decrease.

Average annual precipitation in the study area varies from the 14-15-inch range on valley floors to as high as 60 inches per year in the high peaks of the Anaconda Range. Most of the moisture in the valleys falls during the growing season (April-September). Precipitation in winter generally falls as snow. Winters are cold, but severe cold temperatures are infrequent. Summers in the study area are characterized by warm days and cool nights. The average length of the freeze-free season varies from 100 days or longer in the Bitterroot Valley to less than 30 days in the high mountains.

C. Natural Biota

The study area supports plant and animal communities typical of the forested mountains and intermontane valleys of western Montana. The major vegetation types of the study area are shown on the map entitled "Wildlife Habitat" in the back pocket.

The valley floors, where not altered by agriculture or other human activities, typically support bunchgrass communities, usually dominated by bluebunch wheatgrass. This grassland often extends high into the foothills along drier south-facing slopes, where it provides important winter range for elk and deer. Many of the rolling hills in the John Long Range and Rock Creek Valley support grassland interspersed with timber. The Bitterroot River and Clark's Fork River support stands of riparian cottonwoods along their banks. These lush and highly diverse communities support a great abundance of animal life and offer cover for white-tailed deer and nesting habitat for such birds as the osprey, great blue heron, and red-tailed hawk.

Ascending the foothills from valley bottoms, timber becomes more abundant in response to increased precipitation, especially on north-facing slopes. Ponderosa pine generally dominates the forests on slopes below 5,000 feet, while communities dominated by Douglas fir occur at somewhat higher elevations. These forests provide cover as well as abundant forage for elk, moose, and deer; the diversity of other wildlife is high compared to adjacent grassland.

Where precipitation is higher and temperatures sufficiently low, as in cold air drainages within steep mountain canyons or in high, cool basins, moist subalpine fir communities with an understory of dense shrubbery are found. Spruce, and in some areas on the east slope of the Bitterroots, Grand fir also occur under these conditions. Much of the remaining forested area of mountain ranges of the study area is dominated by somewhat drier subalpine fir communities, usually having an understory of beargrass or huckleberry. Above approximately 8,000 feet are found subalpine and timberline communities, in which whitebark pine (and, rarely, alpine larch) become co-dominant with subalpine fir. Scree and talus slopes, supporting little vegetative cover, are common in areas of high relief and in the higher glaciated peaks. Lodgepole pine occurs as an early-successional dominant throughout the mountainous region. These forest communities provide habitat for variety of montane birds and mammals; of special concern are the black bear, marten, fisher, wolverine, elk, moose, mountain goat, mountain sheep, and forest grouse (see wildlife distribution maps published in section 6.6.). Lush meadows and willow bottoms are found along major streams throughout the mountains; these provide key winter habitat for moose.

The study area contains an excellent sport fishery. The major rivers of the study area support brown trout, rainbow trout, and mountain whitefish, while cutthroat trout and brook trout are typical of smaller mountain tributaries. Trout are found in most of the high mountain lakes of the study area; Georgetown Lake is undoubtedly the most heavily-fished lake in the region. Certain water areas, notably the Ravalli Wildlife Refuge on the Bitterroot River, are high-use areas for waterfowl.

D. Cultural Environment

The land use pattern which has developed in the major valleys of the study area is a function of both the physical properties of the land and local cultural patterns and beliefs. The Bitterroot Valley, which is broad, flat, and contains fertile soil and available water, has become a major agricultural area. Much of the valley bottom supports irrigated cropland, and some dry cropland is found on the foothills of the Sapphires (see Land Use map). Missoula, located at the junction of the Bitterroot and Clark's Fork Valleys, is the largest urban center in the study area, with a population of approximately 30,000. Other major communities in the Bitterroot Valley are Hamilton, Stevensville, and Lolo. Much of the valley has been subdivided, and scattered built-up areas surround the urban centers and small communities.

The Philipsburg Valley area is devoted largely to rural agriculture (mostly irrigated cropland) and rangeland. The major population center in the area is the small town of Philipsburg (population approximately 1,100), located at the edge of the Flint Creek Range.

Agriculture also dominates the Clark's Fork Valley within the study area. The town of Anaconda (population approximately 10,000) stands where Warm Springs Creek enters this valley. Anaconda is the second largest city in the study area, and contains the Washoe Smelter, the largest industrial region in the study area. Georgetown Lake, located between Anaconda and the Philipsburg Valley, is an important recreation center.

The remainder of the study area, which includes the mountainous areas, supports a combination of forest land and rangeland, used variously for logging, mining, grazing, and recreation. The mountains are especially suitable for a variety of outdoor recreational activities. Several relatively large roadless areas remain in the Sapphire Divide and in the Anaconda, Flint Creek, and Bitterroot Ranges (see map entitled "Recreation" in section 6.5.). The Selway-Bitterroot Wilderness Area lies immediately to the west of the study area, and the Anaconda-Pintlar Wilderness area forms part of the southern boundary of the study area.

The social and economic characteristics of the study area, in general, reflect state-wide conditions. The area has developed an economy based on forest products, ranching, agriculture, manufacturing, mining and smelting, and, to a lesser extent, tourism and services. The University of Montana, located in Missoula, is a major cultural center. The Anaconda Company's copper smelter at Anaconda is the area's major industrial site and an important employer for the Anaconda area. With the exception of Missoula and the Bitterroot Valley, the Anaconda area, and Philipsburg, the study area is predominantly rural.

Growth encouragement and desires for rural living have accelerated land use changes and population distribution in the study area. This is especially true in the Bitterroot Valley, where large areas of agricultural land have recently been subdivided.

E. Existing Transportation and Utility Corridors

The existing linear patterns of land use in the study area are shown on the two maps entitled "Road System" in section 6.5. and Existing Transmission Lines" in Chapter Three. U.S. 93, which passes through Missoula and the Bitterroot Valley, is the major north-south transportation corridor in the study area. Interstate 90, Montana's major east-west corridor, passes through the study area in the vicinity of Missoula and Anaconda. U.S. 10A connects Anaconda and Philipsburg with the Clark's Fork Valley to the north of the study area. The only major through road which traverses the mountains of the study area is the Skalkaho Highway, which crosses the Sapphire Divide. This road is gravelled over much of its length.

A number of transmission lines, including two 161 kV lines and one 230 kV line, follow the Clark's Fork River Valley from Missoula to Anaconda. These are joined by an additional 230 kV line in the vicinity of Anaconda, and a third 161 kV line in the vicinity of Missoula. One 161 kV line and two 69 kV lines presently traverse the Bitterroot Valley, connecting Missoula with the Hamilton area (see map entitled "Existing Transmission Lines" in Chapter Three).

CHAPTER TWO

METHODOLOGY

2.1. Introduction

When an application for construction of a transmission line is received by the Department, several phases of the study begin. The alleged need for electrical power is examined, system alternatives to serve such need are studied, the study area is chosen, and work on choosing corridors within the study area begins. It would be most appropriate to first establish need; second, consider all the possible system alternatives; and third, select the transmission corridor. Time and manpower constraints placed upon the Department, however, demand that these studies proceed concurrently.

If the need can be established, then all possible alternatives to serve that need are studied. The applicant's requested transmission line is one alternative, but the Department studies others as well. Chapter Four discusses alternative technologies which are considered. Based upon its findings, the Department recommends to the Board that alternative which seems most practical, economical, and harmonious with the natural and cultural environments.

Departmental staff members are assigned to conduct corridor selection studies related to identified environmental and sociological concerns. Concerns may vary from study to study according to their relevance to individual applications. Six concerns were identified for this study; they are listed and described in more detail in section 2.4.2. below. Individual staff members worked with individual concerns, and generated maps depicting and evaluating the study area in terms of those concerns. One exception is the socioeconomic concern, as such conditions are not easily mapped.

Due to the differences in subject among the various concerns, each concern is handled in a different manner. For example, a study of potential wildlife impacts uses different procedures than a study of potential visual impacts. Individual methods used for the study, writing, and mapping of each concern are explained in Chapter Six.

2.2. Evaluation of Need

Need for additional power or modifications to the existing transmission system in an area can be justified by one of two conditions:

1. Increased electrical load in one or more areas to the extent that existing transmission lines cannot deliver sufficient power. This results in an unacceptable voltage drop in part of the system.

2. Electrical service in some areas having excessive dependence upon a small portion of the transmission system, such as a single line or substation. This can result in low reliability. If one part of the existing system were to fail, the remainder of the system would be unable to serve the load.

As will be discussed in section 2.3., a need for additional power in a particular area does not necessarily require construction of a new transmission line. A line is one way of satisfying a need for electrical power.

Applications for new transmission lines are usually filed in anticipation of future load growths. Establishing future needs of an electrical system involves making projections based upon present loads. In this way, load growth problems can be predicted and provided for before any need occurs. The conventional method of studying load growth is based on the historical growth rate of an area and adjusting it to incorporate known facts that are likely to affect future growth. These studies involve both engineering analyses and socio-economic considerations.

One type of engineering analysis undertaken is a reliability study. This determines the location and extent of system outages should various portions of the system fail. A large part of the existing system must be studied to evaluate the results of such failures, since no part of a transmission system works independently of the rest of the system. The nature of the individual application determines the subject and extent of the engineering analyses required.

2.3. Selection and Evaluation of Alternatives

The alternative chosen to meet an electrical system's needs for additional power must best serve the welfare of the citizens of Montana. This is expressed in the Montana Utility Siting Act in the following words:

> . . . to maintain and improve a clean and healthful environment for present and future generations; to protect the environmental life support system from degradation and prevent unreasonable depletion and degradation of natural resources. . .

Construction of a new transmission line may not always be the best overall alternative, even if most desirable from an engineering standpoint. The optimum alternative is one which solves the electrical needs of the system while striking a balance between greatest reliability, lease cost, and least impact on the cultural and natural environments. The large number of possible alternatives can be grouped into the categories presented below.

1. Upgrade or Expand Existing Systems. In some situations, an existing transmission line can be upgraded to a higher voltage, new conductors can be installed, or compensating equipment can be installed to increase the capacity of the line.

2. Peak Load Management. The peak loads served by a transmission system are considerably higher than average loads. The system must have the capacity to serve the peaks. If peak loads can be reduced by changing the timing on some of the loads (such as domestic water heating or some industrial functions), deficiencies in the existing system can be eliminated without additional transmission lines.

3. System Alternatives. A transmission system includes many lines and substations which work as a whole to deliver power. Many system deficiencies can be solved by more than one arrangement of lines. A problem may be solved by connecting two substations with a transmission line; however, another arrangement of transmission lines and substations may be a more satisfactory solution.

4. Employment of Different Transmission Technology. Electrical power can be transmitted by conventional A.C. transmission lines, by D.C. lines, or by underground conductors.

5. Transmission Voltages and Line Design. Before construction of a conventional transmission line between two points in the system, decisions must be made concerning the voltage level, the size of the conductors, and the design and materials to be used in the support structures. A double circuit 230 kV line built on steel towers differs in many ways from a 69 kV line built on single wooden poles. The impacts are different in kind, as well as degree, and one line could not substitute for another.

6. Alternative Corridors. After a need in the transmission system has been determined, and the alternative of a transmission line connecting two points of the system has been chosen, the task remains of selecting the optimum corridor. A great number of lines can connect two points; the straightest and shortest may not be the best. The method by which the Department evaluates and recommends a corridor is covered in more detail below.

2.4. Corridor Selection

The corridor selected and recommended to the Board is a two-mile-wide strip of land connecting the terminal points in the transmission system. A two-mile-wide corridor is chosen to fulfill the requirement of the Rules and Regulations of the Siting Act and because a large study area cannot be inventoried with sufficient detail to establish all potential centerlines. In addition, a wide corridor allows the applicant and land owners to agree upon the most convenient placement of the centerline and towers. This section describes how the corridor is selected.

2.4.1. Introduction

An infinite number of lines can be drawn between two points. Similarly, a transmission line may follow one of a large number of potential corridors in connecting its terminal points. The optimum corridor, however, is the one which takes into account all the environmental, social, economic, and engineering concerns. When this is done, a smaller number of potential corridors exists.

Ideally, there is only one corridor which is best suited in fulfilling the objectives and concerns of the line. If the sole objective of the line were to keep it as short as possible, a straight line between the terminals is the only route which would fulfill this objective. A transmission line, though, involves many more concerns than its length. The cost of the line is an important consideration; however, the lease expensive line through a given area is not necessarily the shortest. Although least cost is an important concern, the corridor that would achieve this objective would not necessarily be the one most compatible with other interests, such as the crossing of an airport or wilderness area.

Although, ideally, there is only one optimum corridor, it may in practice be difficult to distinguish between a small number of potential routes. Not all persons evaluate the identified concerns in the same way. For example, a hunter may favor a corridor that avoids the range of his favorite game animal, while a hiker may favor a corridor which interferes the least with his favorite hiking trails. Also, every fact potentially relevant to the siting of the line in the study area cannot be known. Thus, the costs and impacts of potential corridors can only be estimated from existing knowledge; actual costs and impacts may vary somewhat from these estimates. A large number of compromises and sometimes conflicting interests thus enter into the selection of the corridor. Some of these are discussed below.

2.4.2. Identification of Concerns

Transmission lines are sometimes controversial because conflicting concerns are involved. The power company and electricity consumers want service at least cost. However, transmission lines cause visual impacts, affect land use, and interact in a number of other ways with the cultural and natural environments. Concerns other than least monetary cost must be considered. Six concerns were identified and studied in the Anaconda-Hamilton transmission line study:

1. Effects on Aquatic Ecosystems
2. Effects on Land Productivity
3. Visual Impacts
4. Effects on Land Use Patterns
5. Effects on Terrestrial Fauna
6. Socio-Economic Concerns

Two concerns that were used by the Department in the Clyde Park-Dillon study (January 1976) which do not appear in this list are (1) greatest reliability, and (2) least cost. Used in this sense, reliability refers to the likelihood of a given section of the transmission line failing due to local causes such as weather conditions and landslides. It should be emphasized that system reliability has a different meaning. The reliability of a well-engineered line which takes into account local hazards is not dependent upon corridor selection.

Cost of a line is important to the applicant and its customers. A list of factors which determine the cost of a line would include the following:

1) Length of line

2) Cost of easements and land

3) Land owner resistance

4) Special engineering problems such as road building

5) Number of transformers or amount of substation construction needed

Many of these factors are not dependent upon the corridor. Since many of these factors cannot be easily mapped, costs were evaluated on alternatives generated by other means.

2.4.3. Concern Maps

Although differences in procedure occur in the studies conducted upon the various concerns, the studies (except the socio-economic study) each produced a map. These maps were all handled in the same manner. This section describes the methods by which the maps were used to select a two-mile-wide corridor.

Seven maps were generated which rated the study area in six categories. That is, each point in the area is rated on a scale of zero to five based upon the amount of impact a transmission line would have on that spot in terms of the concern represented by the map. The scale values are:

0 - no relationship, no impact, or insignificant impact

1 - significant, but slight impact

2 - moderate impact

3 - large impact

4 - severe impact

5 - no relationship to impact, but legally prohibited
(such as across airports)

A problem arises when equating these ratings to units (or amount) of impact. A rating of four is used to represent a severe disruption to the system. A one is used to represent the smallest significant impact mapped. But the smallest significant impact mapped is not a full one-fourth the impact of a severe disruption. Some scaling or equivalence function was needed.

The equivalence function chosen was: units of impact = $(\text{rating})^2$ with the exception of the rating five, which was treated as a legally prohibited area. Thus, a rating of two has approximately four times the impact of a rating of one, a rating of three has approximately nine times the impact of a rating of one, etc. The Department used the professional judgement of its staff in rating the concern maps to this rating scale. The seven maps representing the concerns are:

1. Wildlife Composite
2. Aquatic Ecosystems Composite
3. Recreation
4. Existing Land Use--Site Patterns
5. Visual Analysis--Potential Impacts
6. Agriculture and Range Productivity
7. Forest Productivity

Each of these maps was generated by procedures described in the appropriate sections of Chapter Six; they are all reproduced within this publication.

2.4.4. Composite Maps

To facilitate the choosing of a corridor, the computer was used to combine the seven concern maps into composite maps. The task of studying these seven concern maps and judging the effect of each on the choice of the corridor is difficult at best. This method of combining the maps not only eases the task, but also allows the flexibility to try different weightings of the concerns to produce more than one composite. A definitely superior corridor should show up in several of the composites. The following discussion describes the steps of the process.

Each investigator collects data from existing literature or original research (aerial photographs and field work) and portrays this information on a map of the study area. As mentioned above, examples of these maps can be found in Chapter Six. Such categories as the distribution of game animals, the location of golf courses, and existing roads are portrayed. Numerous maps showing patterns of the cultural and natural environments and features that could be affected by a transmission line are thus produced.

Each map category is then rated for compatibility with a transmission line in terms of one of the five mapped concerns (as mentioned previously, socio-economic concerns are not readily mappable). For example, the study area's forests were mapped according to habitat type. The investigator then evaluated each habitat type and assigned it a productivity category which reduced the amount of detail and the number of categories to five. A version of this derived map was drafted and prepared for scanning by the computer. The productivity categories were given the ratings of zero to four as described previously. All such inventory maps were treated in this manner to generate the concern maps. Concern maps, except the wildlife and sediment risk maps, were scanned by the computer.

The wildlife and sediment risk concern maps were generated using the computer in an additional step. Figure 2-1 illustrates which maps were scanned and combined to generate these two concern maps.

Once the maps have been scanned by the computer (digitized), the information on the map then exists on magnetic tapes. In this form, information from one map can be combined in a number of ways with other maps to produce an entirely new map. The composite map is such a map.

In order to combine these seven maps drawn from different concerns into a single composite, the maps must be drawn of the same or relatable units. The concern maps are drawn in units of impact.

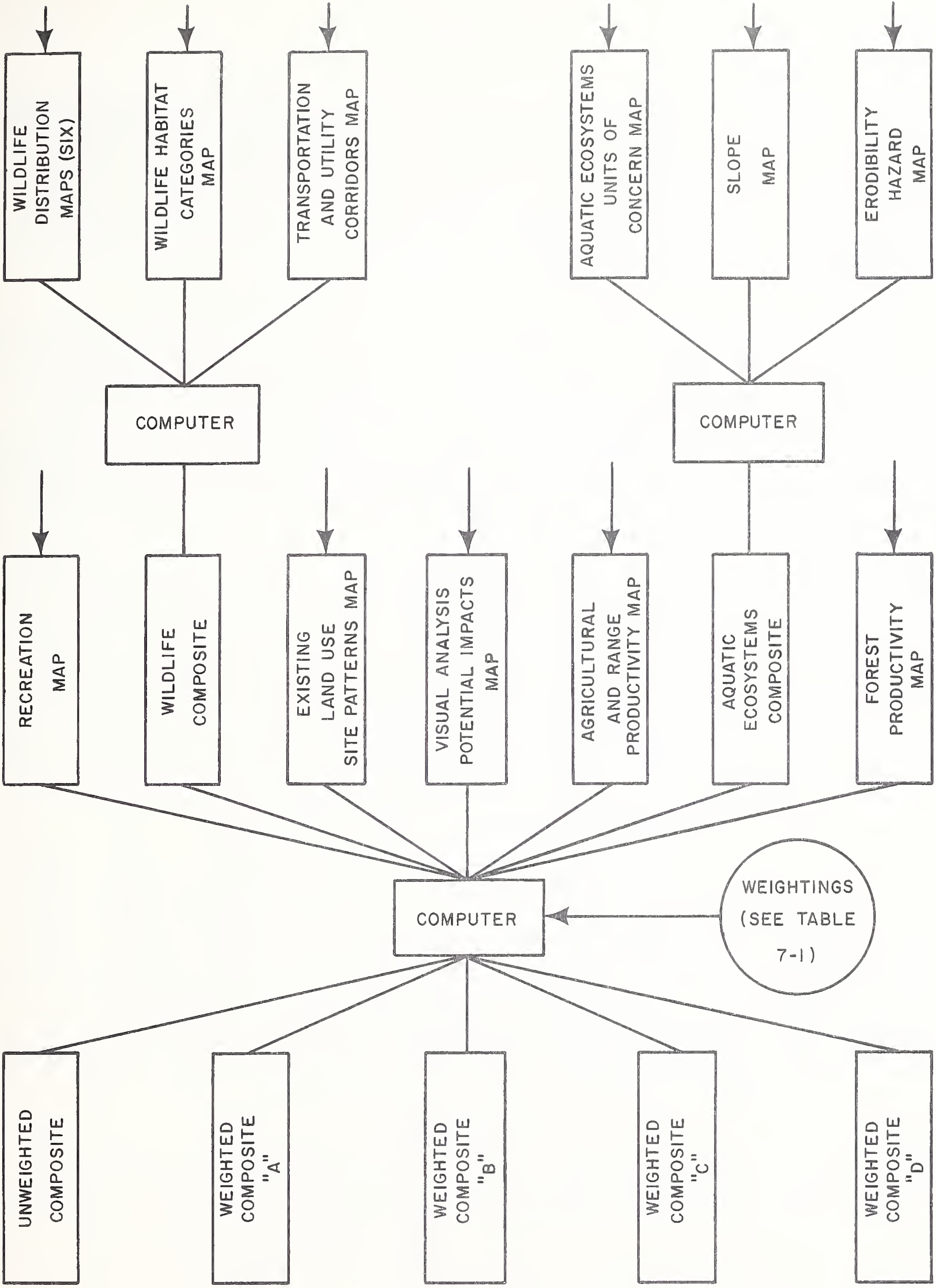
In making the composite, a simple weighted average, along with the equivalence function mentioned earlier, is used. Figure 2-2 is an example of how a cell, with the given ratings, would be evaluated using the given weights. These weights are given only as illustration and were not used to make a composite.

A number of composite maps can be generated using different weightings. The weightings used are shown in Chapter Seven. Corridors can then be chosen on the composites and compared. The Department's staff has found that some corridors were shown to be obviously superior to others no matter which of these sets of weightings were used.

It should be noted that the computer does not draw a line on a map showing the best corridor. The Department's professional staff members evaluate these maps in light of their knowledge of the study area. The recommendation to the Board will be based upon a consideration of many factors, including the computer-generated maps.

2.4.4.1. Some Details of Digitizing

The maps were digitized into a cellular format with a raster scanner. All the maps prepared for the computer were drawn to the same scale and were digitized with the same resolution. Registration marks were drawn on all the maps for use in lining up the digitizing equipment. Thus, an accurate overlay or combination of these maps can be made by allowing the computer to examine the files on a cell-by-cell basis.


WILDLIFE DISTRIBUTION MAPS (SIX)
WILDLIFE HABITAT CATEGORIES MAP
TRANSPORTATION AND UTILITY CORRIDORS MAP
AQUATIC ECOSYSTEMS UNITS OF CONCERN MAP
SLOPE MAP
ERODIBILITY HAZARD MAP
COMPUTER
COMPUTER
RECREATION MAP
WILDLIFE COMPOSITE
EXISTING LAND USE SITE PATTERNS MAP
VISUAL ANALYSIS POTENTIAL IMPACTS MAP
AGRICULTURAL AND RANGE PRODUCTIVITY MAP
AQUATIC ECOSYSTEMS COMPOSITE
FOREST PRODUCTIVITY MAP
COMPUTER
WEIGHTINGS (SEE TABLE 7-1)
UNWEIGHTED COMPOSITE
WEIGHTED COMPOSITE "A"
WEIGHTED COMPOSITE "B"
WEIGHTED COMPOSITE "C"
WEIGHTED COMPOSITE "D"

RELATIONSHIPS OF THE MAPS USED IN THE CORRIDOR SELECTION PROCESS OF THIS STUDY

(ARROWS INDICATE INPUT OF ORIGINAL RESEARCH AND LITERATURE REVIEW)

Figure 2-1

The computer maps were prepared at a scale of 1:250,000. This produces a map approximately 18 by 18 inches over the study area; the maximum scanning area on the raster scanner is approximately 10 by 22 inches. The maps were cut horizontally, approximately 9 inches from the bottom. A full 10 inches of scanning was used in the vertical direction to allow for registration marks and some overlap of the top and bottom halfs of the maps. Before the two halves are joined, the appropriate sections of the top and bottom halves are extracted so that the joint will be made accurately.

The maps were scanned at a resolution of 100 lines per inch. Thus, the cell size of the raw data is .0016 square mile. These files were aggregated by a factor of 20 to 1, giving a cell size of .032 square mile. Areas 5 by 4 were allowed to be represented by a single cell, having whichever value was dominant in the 5 by 4 matrix. Some additional flexibility is allowed in this aggregation, but is beyond the scope of this text. The larger cell size was used in the composite maps, concern maps, and the eleven level one maps.

Concern:	Wildlife	Sediment Risk	Recreation	Land Use	Visual Analysis	Agricultural Productivity	Forest Productivity	Weighted Average in Units of Impact	Equivalent Rating	Rating Used (nearest whole number)
Weight:	2	2	2	1	3	3	1			
Rating within an associated cell:	2	2	0	1	1	0	3			
Units of Impact:	4	4	0	1	1	0	9	2.07	1.44	1

Figure 2-2

CHAPTER THREE

ELECTRICAL NEED

3.1. Introduction

The purpose of this chapter is to address the question of electrical need as related to the proposed transmission line project. Considering electrical need only, a transmission line may be needed to meet an electrical load growth of an area or to increase the reliability of the transmission system. The applicant anticipates that continued load growth in the Bitterroot Valley will render the reliability of the existing transmission system inadequate, and proposes the Anaconda-Hamilton line to correct the projected inadequacy. Additional justifications offered for the Anaconda-Hamilton line include the need to provide "adequate and reliable service" to the city of Missoula, and the benefits of an additional potential power source to the Philipsburg area.

In the following sections the various components of the need proferred by the applicant will be examined, including the existing transmission system (section 3.2.), the available load growth projections (section 3.3.), the affect considerations of electrical need (section 3.4.), and system reliability and problem service areas (section 3.5.).

3.2. Existing Electrical System

The electrical loads in the study area are served by the applicant Montana Power Company (MPC), the Ravalli County Electric Cooperative, and the Missoula Electric Cooperative. The applicant provides power to all incorporated towns, most small communities, and a small portion of the rural areas. The cooperatives primarily serve rural areas, with the Ravalli County Electric Cooperative responsible for most of rural Ravalli County, and the Missoula Electric Cooperative for portions of rural Missoula, Granite, and Ravalli Counties.

All three utilities serve loads in the Bitterroot Valley. Table 3-1 lists the Valley delivery points for each utility. To provide service in the Valley, the Cooperatives purchase power from the Bonneville Power Administration (BPA), which in turn, through a cooperative agreement with the MPC, supplies the power over the MPC transmission system.

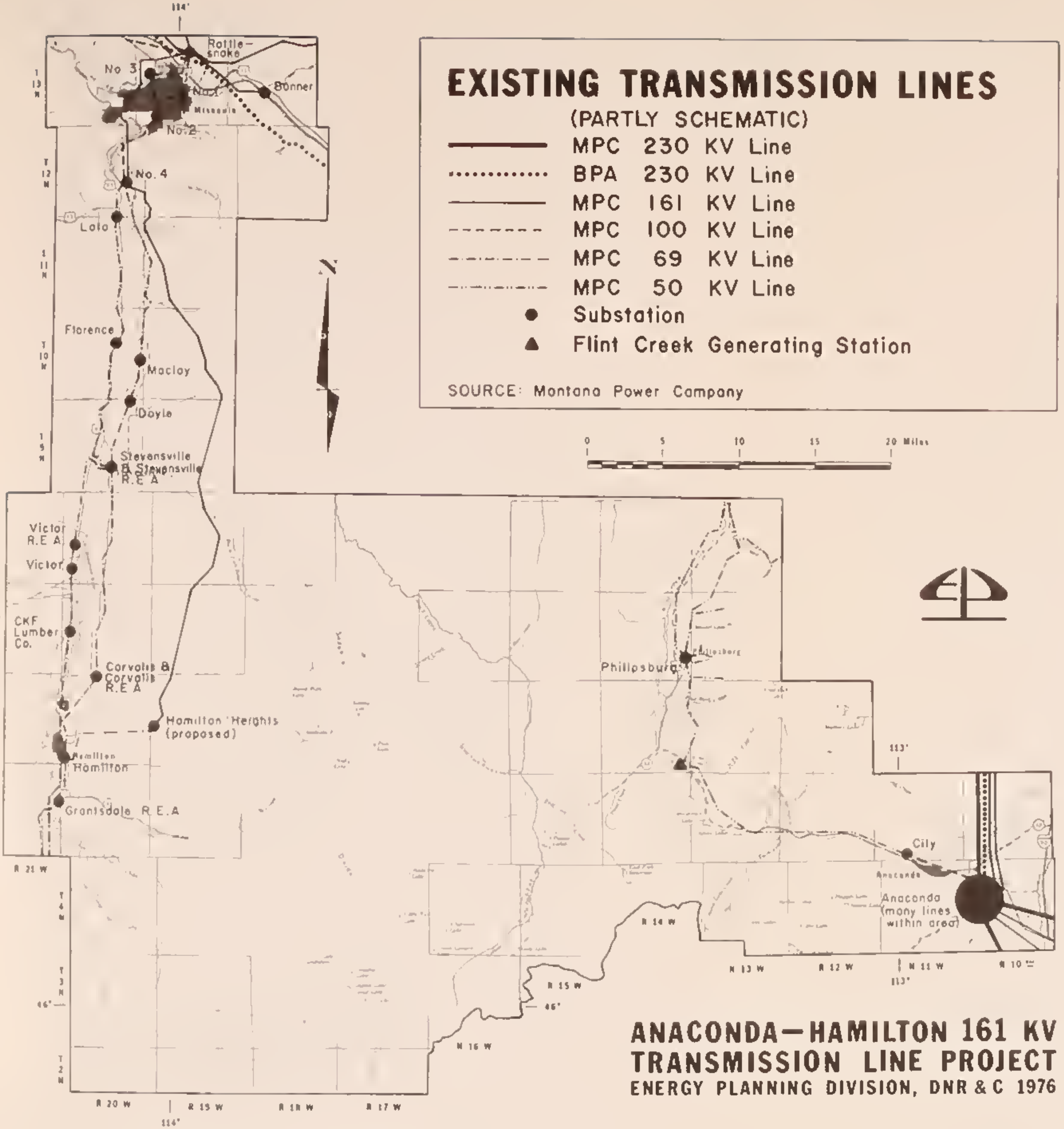
The transmission system in the study area is shown in the map entitled "Existing Transmission Lines." Three transmission lines are now located in the Bitterroot Valley--two 69 kV lines and one 161 kV line. This latter line is currently operated at only 69 kV, but is projected to be energized at 161 kV in 1977. The two 69 kV lines which extend from Missoula to Darby deliver power from both Missoula and Hamilton to Bitterroot Valley distribution substations. At the Missoula end, power enters the 69 kV lines directly from Missoula substations. At Hamilton power enters the lines indirectly from the Missoula substations via the Missoula-Hamilton Heights 161 kV line. All three of these lines are owned and operated by the applicant; neither BPA nor the

TABLE 3-1

BITTERROOT VALLEY DELIVERY POINTS

Montana Power Company	Ravalli County Electric Cooperatives	Missoula Electric Cooperative
Lolo	Corvallis	Lolo
Florence	Darby	
Stevensville	Grantsdale	
Victor	Stevensville	
Hamilton	Victor	
Corvallis		
Darby		

SOURCE: Montana Power Company, Bonneville Power Administration



EXISTING TRANSMISSION LINES

(PARTLY SCHEMATIC)

SOURCE: Montana Power Company

ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

cooperatives own transmission lines in the Bitterroot Valley. Data relating to these and other transmission lines in the Missoula-Anaconda area are given in Table 3-2.

3.3. Electrical Load Growth Projections

As stated in the introductory section of this chapter, the applicant anticipates continued electrical load growth in the study area. Detailed historical and estimated future load data supplied by the applicant for the Bitterroot Valley and Philipsburg is discussed in Section 3.3.2. In addition, similar data relating to the Bitterroot Valley provided by BPA and the two cooperatives will be discussed in Section 3.3.1.

3.3.1. BPA and Cooperatives' Load Growth Projections

In conjunction with the respective cooperatives, BPA published a Load Study and Plan of Service for the Ravalli County Electric Cooperative in May 1972, and for the Missoula Electric Cooperative in June 1973. These studies contain economic background data, detailed load forecast, and specific proposals for system improvements for each cooperative.

The approach used by BPA in preparing the study load forecasts is described in the two studies themselves, and also in Load Estimating Manual - A Guide for the Preparation of Load Studies (BPA July 1965). An excerpt from the Load Estimating Manual summarizes the basic load projection methodology:

> This manual describes a method of estimating by component parts which will develop an informative and reliable load estimate . . . . Electric consumers are grouped into classes, such as domestic, commercial, large power, irrigation, and others. The probable number of customers to be served in future years and the average use of electricity by each class are estimated and used to determine the utility's total load. In order to arrive at reasonable assumptions concerning these items, an analysis of the economic factors affecting the service area is required.

Tables 3-3, 3-4, and 3-5 contain Bitterroot Valley electric cooperatives' load data taken from the two BPA studies. Tables 3-3 and 3-4 show the historical and estimated future electrical consumption for the total system of the Ravalli County Electric Cooperative. Included in these tables is the historic or projected increase in number of customers per load forecasting class, as well as in electrical consumption per customer in each class. Similar load projection data for the Cooperative's 1972 individual Bitterroot Valley power delivery points of Corvallis, Darby, Grantsdale, and Stevensville are given in Tables I through VI in Appendix A. The estimated future loads at the Lolo delivery point in the Missoula Electric Cooperative system are given in Table 3-5.

TABLE 3-2

EXISTING TRANSMISSION LINE DATA

Line	Wire Size or Code No.	Length (miles)	Year Constructed	Present Load in MW (1976 base case)	Thermal Capacity
Missoula-Hamilton-Darby 69 kV A	A3/0,A2 C4Y	63.2	1910	?	21 MVA 8 MW
Missoula-Hamilton-Darby 69 kV B	C2X, A3/0	62.4	1947	?	28 MVA 7 MW
Missoula-Hamilton Heights 69/161 kV	556	40.0	1973	15.1	204 MVA ? MW
Anaconda-Philipsburg-Drummond 50 kV	C2X, C3S9, C3S8, C6, C2Y, C1/0, C758, C1/0H	52.7	1937	?	10 MVA ?
Anaconda-Missoula 161 kV A (Mill Cr.-Rattlesnake A)	C350	89.0	1936	33.5	187 MVA ?
Missoula-Kerr 161 kV A (Rattlesnake A-Kerr A)	C350	56.1	1936	34.2	187 MVA ?
Anaconda-Missoula 161 kV B (Mill Cr.-Rattlesnake B)	A556	92.8	1959	33.6	204 MVA ?
Missoula-Kerr 161 kV B (Rattlesnake B-Kerr B)	A556	57.0	1957	34.8	204 MVA ?
Anaconda-Ovando 230 kV (Mill Cr.-Ovando)	A1272	59.7	1965	111.5	478 MVA ?
Ovando-Hot Springs 230 kV	A1272	89.7	1965	53.8	478 MVA ?

SOURCE: Montana Power Company, April 20, 1976. Written correspondence to Department.

TABLE 3-3

HISTORICAL LOAD DATA
RAVALLI COUNTY ELECTRIC CO-OP

	1966	1967	1968	1969	1970	1971
AVERAGE NO. OF CUSTOMERS						
Domestic	896	935	1,000	1,042	1,123	1,245
Seasonal Domestic	106	103	110	122	129	140
Commercial	54	51	56	55	48	55
Large Power	8	8	8	7	6	6
Irrigation	303	321	339	350	364	377
Street Lighting Public Authorities	4	4	4	4	8	8
TOTAL	1,371	1,422	1,517	1,580	1,678	1,831
KWH PER CUSTOMER						
Domestic	13,483	14,140	14,960	16,275	16,658	17,583
Seasonal Domestic	1,057	1,350	1,209	1,164	1,415	1,457
Commercial	13,167	15,216	15,000	16,836	22,111	22,982
Irrigation	16,568	15,396	15,737	17,086	16,665	19,271
Street Lighting Public Authorities	6,290	6,383	5,965	7,589	16,125	17,500
ENERGY SALES (MWH)						
Domestic	12,081	13,221	14,960	16,959	18,708	21,890
Seasonal Domestic	112	139	133	142	183	204
Commercial	711	776	840	926	1,061	1,264
Large Power	6,584	6,923	7,431	8,363	7,688	8,232
Irrigation	5,020	4,942	5,335	5,980	6,066	7,265
Street Lighting Public Authorities	25	26	24	30	129	140
Utility Use	65	76	90	118	159	245
TOTAL	24,598	26,103	28,813	32,518	33,994	39,240

TABLE 3-3 (continued)

	1966	1967	1968	1969	1970	1971
PERCENT LOSS	10.2	9.9	10.0	10.3	10.0	9.9
Energy Requirements	27,380	28,975	32,008	36,264	37,763	43,555
Annual Load Factor	55.5	51.9	52.2	52.9	50.1	50.4
Annual Peak Demand (KW)	5,636	6,377	6,979	7,826	8,610	9,870
Month of Annual Peak	May	Dec.	June	Jan.	Jan.	Dec.
January Peak (KW)	5,361	5,392	6,300	7,826	8,610	8,806
August Peak (KW)	5,504	5,943	6,615	6,923	7,504	8,246
December Peak (KW)	5,196	6,377	6,643	7,350	7,812	9,870

SOURCE: U.S. Department of the Interior, Bonneville Power Administration 3/72.

NOTE: Point of Delivery -- Total System.

TABLE 3-4

ESTIMATED LOAD DATA
RAVALLI COUNTY ELECTRIC CO-OP

	1972	1973	1974	1975	1976	1981
AVERAGE NO. OF CUSTOMERS						
Domestic	1,420	1,540	1,660	1,780	1,900	2,500
Seasonal Domestic	153	163	173	183	193	243
Commercial	58	60	62	64	66	76
Large Power	6	6	6	6	6	6
Irrigation	391	405	419	433	447	517
Street Lighting						
Public Authorities	7	7	7	7	7	7
TOTAL	2,035	2,181	2,327	2,473	2,619	3,349
KWH PER CUSTOMER						
Domestic	17,950	18,650	19,340	20,040	20,740	24,240
Seasonal Domestic	1,540	1,640	1,740	1,840	1,940	2,430
Commercial	23,670	24,450	25,240	26,030	26,830	30,790
Irrigation	19,320	20,000	20,680	21,350	22,000	25,230
Street Lighting						
Public Authorities	21,710	22,140	22,570	23,000	23,430	25,570
ENERGY SALES (MWH)						
Domestic	25,485	28,715	32,111	35,677	39,409	60,595
Seasonal Domestic	236	267	301	336	374	590
Commerial	1,373	1,467	1,565	1,666	1,771	2,340
Large Power	8,600	8,800	9,010	9,210	9,420	10,440
Irrigation	7,555	8,101	8,664	9,243	9,835	13,042
Street Lighting						
Public Authorities	152	155	158	161	164	179
Utility Use	250	255	260	265	270	295
TOTAL	43,651	47,760	52,069	56,558	61,243	87,481

TABLE 3-4 (continued)

	1972	1973	1974	1975	1976	1981
PERCENT LOSS	10.0	10.0	10.0	10.0	10.0	10.0
Energy Requirements	48,510	53,070	57,850	62,840	68,050	97,210
Annual Load Factor	48.3	49.0	49.2	49.2	49.3	49.6
Annual Peak Demand (KW)	11,470	12,370	13,430	14,570	15,750	22,380
Month of Annual Peak	Jan.	Jan.	Jan.	Jan.	Jan.	Jan.
January Peak (KW)	11,470	12,370	13,430	14,570	15,750	22,380
August Peak (KW)	9,350	9,930	10,570	11,220	11,920	16,160
December Peak (KW)	11,130	12,030	13,100	14,220	15,390	22,010

SOURCE: U.S. Department of the Interior, Bonneville Power Administration 3/72

NOTE: Point of Delivery -- Total System.

TABLE 3-5

ESTIMATED SYSTEM LOAD
BY POINTS OF DELIVERY
MISSOULA ELECTRIC CO-OP

	1973	1974	1975	1976	1977	1982
LOLO						
Annual Energy MWH	12,540	14,790	17,170	19,700	22,420	38,200
Annual Load Factor	46.5	46.4	46.3	46.3	46.3	46.1
Annual Peak KW	3,080	3,640	4,230	4,860	5,530	9,460
Month of Annual Peak	Jan.	Jan.	Jan.	Jan.	Jan.	Jan.
January Peak KW	3,080	3,640	4,230	4,860	5,530	9,460
August Peak KW	1,460	1,730	2,010	2,310	2,630	4,500
December Peak KW	3,020	3,580	4,170	4,800	5,470	9,400

SOURCE: U.S. Department of the Interior, Bonneville Power Administration 3/73.

Because the two BPA studies were published in 1972 and 1973, BPA was asked if the components of the load forecasts (e.g., the expected annual increase in domestic customers, average electrical energy consumption per domestic customer, etc.) have been updated since completion of the two studies. The BPA replied that such updating would require a full-scale load study and that "such a study will be made when necessary as indicated by a comparison of actual with estimated loads (BPA January 16, 1976)." The most recent BPA load projections (as of December 31, 1975), based upon the 1972 and 1973 load forecasting class data, for the total Ravalli County Electric Cooperative System and Lolo in the Missoula Electric Cooperative system are shown in Tables 3-6 and 3-7. The load projections are made on a monthly basis for the 1975 to 1995 period. Similar data for the present individual Ravalli Cooperative power delivery points are located in Tables VII through XI in Appendix A.

3.3.2. Applicant's Load Projections

In the application and subsequent correspondence with the Department, the applicant has mentioned or discussed anticipated electrical load growth in the Bitterroot Valley, Philipsburg, and Missoula areas. The factors underlying continued growth, according to the applicant, are presented by area in section 3.3.2.1. The actual load projections and projection methodology will be covered in section 3.3.3.

3.3.2.1. General Factors Contributing to Load Growth Bitterroot Valley

In the Bitterroot Valley, the applicant projects an increase in electrical load of 8% per year through 1985. This increase is based in part on a history an average 8% annual growth from 1948 to 1973, and in part upon air average 11% annual growth from 1963 to 1973. The primary factors cited by the applicant for the 11% growth rate in the 1963-1973 decade are "Residential housing, irrigation, and the logging industry . . ." (MPC, December 31, 1974). Continued growth is expected by the applicant because of general population growth, use of electric heating in new residential and commercial facilities, conversion of existing heating systems to electric heating, and continued irrigation load growth.

U.S. Bureau of the Census data demonstrate that Ravalli County has experienced population growth in the recent past. From 1960 to 1970, Ravalli County population grew 11%, from 12,341 to 14,409 inhabitants. Table 3-8 contains the Census Bureau mid-year population estimates for the year 1971 through 1975 for the four counties contained partially within the study area. These data indicate continued growth through 1975.

Information supplied by the applicant, shown in Table 3-9, indicates an increase in total customers and in the installation of, or conversion to, electric heating in the Bitterroot Valley area. During the three-year period from 1973 to 1975, for which data are available, the applicant's Valley customers increased by 447, with 47 electric heat installations. In response to

TABLE 3-6

BPA LOAD PROJECTIONS
RAVALLI ELECTRIC CO-OP

		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	FY.Av	CY.Av
1975-76	Tot Pk MW	10.7	11.2	10.6	10.9	12.5	14.3	15.8	14.3	12.8	11.2	10.9	11.0	12.2	
	Tot Av MW	7.2	7.3	7.1	6.5	7.6	8.5	9.0	8.5	7.4	6.6	6.4	7.5	7.5	
1976-77	Tot Pk MW	11.5	11.9	11.5	11.7	13.5	15.4	16.7	15.4	13.7	12.0	11.6	11.8	13.1	12.6
	Tot Av MW	7.9	8.0	7.7	6.9	8.1	9.0	9.7	9.0	7.8	7.1	6.9	8.0	8.0	7.7
1977-78	Tot Pk MW	12.3	12.7	12.3	12.4	14.6	16.5	18.0	16.5	15.0	12.8	12.5	12.5	14.0	13.5
	Tot Av MW	8.4	8.5	8.3	7.5	8.9	9.7	10.5	9.7	8.6	7.7	7.6	8.7	8.7	8.3
1978-79	Tot Pk MW	13.2	13.5	13.1	13.3	15.9	17.9	19.4	17.8	16.2	13.9	13.4	13.5	15.1	14.5
	Tot Av MW	8.9	9.1	9.0	8.0	9.5	10.6	11.3	10.6	9.1	8.1	8.1	9.3	9.3	9.0
1979-80	Tot Pk MW	14.0	14.3	14.1	14.3	17.1	19.3	20.9	19.3	17.5	15.0	14.5	14.5	16.2	15.6
	Tot Av MW	9.6	9.8	9.6	8.7	10.4	11.3	12.1	11.3	9.8	8.9	8.5	9.9	10.0	9.7
1980-81	Tot Pk MW	14.9	15.3	14.9	15.5	18.4	20.7	22.3	20.7	18.7	16.0	15.7	15.6	17.4	16.8
	Tot Av MW	10.4	10.5	10.3	9.4	11.	12.2	13.0	12.2	10.6	9.4	9.3	10.6	10.7	10.4
1981-82	Tot Pk MW	15.9	16.1	15.9	16.5	19.7	22.1	23.7	21.1	20.0	17.0	16.6	16.5	18.5	17.9
	Tot Av MW	10.9	11 0	10.9	10.0	11.8	13.1	13.9	13.1	11.4	10.0	9.9	11.2	11.4	11.1
1982-83	Tot Pk MW	17.0	17.3	17.0	17.6	21.1	23.5	25.3	23.5	21.3	18.2	17.6	16.6	19.8	19.1
	Tot Av MW	11.8	11.9	11.6	10.7	12.5	13.9	14.7	13.9	12.1	10.7	10.5	11.9	12.2	11.8

TABLE 3-6 (continued)

		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	FY.Av	CY.Av
1983-84	Tot Pk MW	18.2	18.5	18.3	18.9	22.6	25.1	27.1	25.1	22.8	19.4	19.0	18.8	21.1	20.4
	Tot Av MW	12.6	12.7	12.4	11.4	13.4	14.8	15.7	14.8	12.9	11.3	11.2	12.8	13.0	12.6
1984-85	Tot Pk MW	19.5	19.8	19.6	20.1	24.1	26.8	28.8	26.8	24.3	20.7	20.3	20.1	22.6	21.8
	Tot Av MW	13.4	13.5	13.2	12.2	14.3	15.7	17.0	15.7	13.8	12.1	12.0	13.6	13.9	13.4
1985-86	Tot Pk MW	20.8	21.1	20.9	21.4	25.7	28.6	30.7	28.6	25.9	22.2	21.7	21.4	24.1	23.3
	Tot Av MW	14.3	14.5	14.1	13.0	15.2	16.8	18.1	16.8	14.7	12.9	12.9	14.5	14.8	14.3
1986-87	Tot Pk MW	22.1	22.5	22.2	22.8	27.4	30.4	32.8	30.4	27.7	23.7	23.2	22.9	25.7	
	Tot Av MW	15.3	15.5	15.1	13.9	16.3	17.9	19.2	17.9	15.7	13.8	13.8	15.7	15.8	
1987-88	Tot Pk MW	23.7	24.0	23.8	24.3	29.3	32.5	25.0	32.5	29.5	25.3	24.7	24.4	27.4	26.5
	Tot Av MW	16.4	16.6	16.2	14.8	17.3	19.1	20.5	19.1	16.7	14.7	14.7	16.7	16.9	16.4
1988-89	Tot Pk MW	25.3	25.7	25.4	26.0	31.3	34.6	37.1	34.6	31.5	27.0	26.3	26.0	29.2	28.3
	Tot Av MW	17.5	17.7	17.2	15.8	18.5	20.3	22.1	20.5	17.8	15.6	15.7	17.8	18.0	17.4
1989-90	Tot Pk MW	26.8	27.3	27.0	27.6	33.2	36.9	39.6	36.9	33.5	28.7	28.0	27.7	31.1	30.1
	Tot Av MW	18.6	18.9	18.3	16.9	19.6	21.8	23.3	21.7	19.0	16.7	16.7	18.9	19.2	18.6
1990-91	Tot Pk MW	28.7	29.0	28.8	29.3	35.3	39.3	42.1	39.3	35.6	30.5	30.0	29.5	33.1	32.1
	Tot Av MW	19.8	20.1	19.6	17.9	20.9	23.1	24.9	23.1	20.3	17.8	17.7	20.3	20.5	19.8
1991-92	Tot Pk MW	30.5	30.9	30.5	31.2	37.6	41.8	44.9	41.7	38.0	32.5	31.6	31.4	35.2	34.1
	Tot Av MW	21.2	21.5	20.7	19.0	22.3	24.6	26.6	24.6	21.6	18.9	18.9	21.6	21.8	21.1

TABLE 3-6 (continued)

		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	FY.Av	CY.Av
1992-93	Tot Pk MW	32.5	33.0	32.6	33.2	39.9	44.3	47.7	44.3	40.3	34.6	33.8	33.5	37.5	36.3
	Tot Av MW	22.6	22.9	22.1	20.2	23.8	26.2	28.4	26.3	22.9	20.2	20.3	23.0	23.2	22.5
1993-94	Tot Pk MW	34.6	35.0	34.5	35.3	42.3	47.1	50.7	47.1	42.9	36.7	35.9	35.6	39.8	38.6
	Tot Av MW	24.0	24.3	23.5	21.4	25.0	27.8	30.1	27.7	24.3	21.4	21.4	24.4	24.6	23.9
1994-95	Tot Pk MW	36.6	37.1	36.7	37.3	45.0	50.1	53.7	50.1	45.5	38.9	38.2	37.8	42.2	41.0
	Tot Av MW	25.5	25.8	25.0	22.8	26.7	29.6	31.9	29.5	25.9	22.7	22.7	26.0	26.2	25.4

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, Branch of Power Resources 11/26/74

NOTE: Total -- All Delivery Points

TABLE 3-7

BPA LOAD PROJECTIONS
MISSOULA ELECTRIC CO-OP

		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	FY.Av	CY.Av
1975-76	Peak MW	2.0	2.0	2.4	2.8	3.6	4.2	4.9	4.0	3.5	3.3	3.0	2.7	3.2	
	Average MW	1.5	1.4	1.7	1.9	2.3	2.7	2.9	2.6	2.3	2.2	1.9	1.8	2.1	
1976-77	Peak MW	2.3	2.3	2.7	3.2	4.1	4.8	5.5	4.6	4.0	3.7	3.5	3.0	3.6	3.4
	Average MW	1.8	1.6	1.9	2.2	2.6	3.1	3.3	3.0	2.7	2.5	2.2	2.0	2.4	2.2
1977-78	Peak MW	2.6	2.6	3.1	3.7	4.7	5.5	6.1	5.0	4.4	4.2	3.9	3.4	4.1	3.9
	Average MW	2.0	1.8	2.2	2.5	3.0	3.5	3.7	3.3	3.0	2.8	2.4	2.2	2.7	2.6
1978-79	Peak MW	2.9	2.9	3.4	4.1	5.2	6.1	6.8	5.7	4.9	4.6	4.4	3.8	4.6	4.3
	Average MW	2.2	2.0	2.4	2.8	3.3	3.9	4.1	3.7	3.3	3.1	2.7	2.5	3.0	2.8
1979-80	Peak MW	3.2	3.2	3.8	4.6	5.8	6.8	7.6	6.3	5.5	5.1	4.9	4.2	5.1	4.8
	Average MW	2.5	2.3	2.7	3.1	3.7	4.3	4.5	4.1	3.7	3.4	3.1	2.8	3.3	3.2
1980-81	Peak MW	3.6	3.6	4.2	5.0	6.4	7.6	8.5	7.0	6.1	5.6	5.4	4.7	5.6	5.3
	Average MW	2.8	2.6	3.0	3.4	4.1	4.8	5.0	4.6	4.1	3.7	3.4	3.1	3.7	3.5
1981-82	Peak MW	4.0	4.0	4.7	5.6	7.2	8.4	9.5	7.8	6.8	6.1	6.0	5.3	6.3	5.9
	Average MW	3.1	2.9	3.3	3.8	4.6	5.4	5.6	5.1	4.6	4.1	3.8	3.5	4.1	3.9
1982-83	Peak MW	4.5	4.5	5.3	6.2	8.0	9.4	10.6	8.8	7.6	6.7	6.7	5.9	7.0	6.6
	Average MW	3.4	3.2	3.7	4.2	5.1	6.0	6.2	5.7	5.1	4.5	4.2	3.9	4.6	4.4
1983-84	Peak MW	5.0	5.0	5.9	7.0	8.9	10.5	11.8	9.8	8.4	7.5	7.5	6.7	7.8	7.4
	Average MW	3.8	3.6	4.1	4.7	5.7	6.6	6.8	6.3	5.7	5.0	4.7	4.3	5.1	4.8

TABLE 3-7 (continued)

		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	FY.Av	CY.Av
1984-85	Peak MW	5.6	5.6	6.6	7.7	9.8	11.6	13.2	10.8	9.3	8.2	8.4	7.4	8.7	8.2
	Average MW	4.2	4.0	4.6	5.2	6.3	7.2	7.4	7.0	6.3	5.5	5.3	4.7	5.6	5.4
1985-86	Peak MW	6.2	6.2	7.3	8.5	10.9	12.8	14.6	12.0	10.3	9.1	9.3	8.2	9.6	9.1
	Average MW	4.7	4.4	5.1	5.6	7.0	8.0	8.2	7.8	7.0	6.1	5.9	5.2	6.3	5.9
1986-87	Peak MW	6.9	6.9	8.1	9.4	12.1	14.2	16.2	13.3	11.4	10.1	10.3	9.1	10.7	
	Average MW	5.2	4.9	5.6	6.4	7.8	8.9	9.1	8.6	7.8	6.8	6.5	5.8	6.9	
1987-88	Peak MW	7.6	7.6	8.9	10.4	13.4	15.7	17.9	14.7	12.6	11.1	11.4	10.0	11.8	11.2
	Average MW	5.8	5.4	6.2	7.1	8.6	9.8	10.0	9.6	8.6	7.5	7.2	6.4	7.7	7.3
1988-89	Peak MW	8.4	8.4	9.9	11.5	14.8	17.3	19.8	16.2	13.9	12.3	12.6	11.1	13.0	12.3
	Average MW	6.4	6.0	6.9	7.8	9.5	10.8	11.1	10.6	9.5	8.3	8.0	7.0	8.5	8.1
1989-90	Peak MW	9.3	9.3	10.9	12.7	16.3	19.1	21.8	17.9	15.4	13.6	13.9	12.2	14.4	13.6
	Average MW	7.0	6.6	7.6	8.7	10.4	11.9	12.2	11.6	10.4	9.1	8.8	7.8	9.3	8.9
1990-91	Peak MW	10.2	10.2	12.0	14.0	17.9	21.0	24.0	19.7	16.9	15.0	15.3	13.5	15.8	15.0
	Average MW	7.7	7.2	8.4	9.5	11.5	13.2	13.5	12.8	11.5	10.0	9.7	8.6	10.3	9.8
1991-92	Peak MW	11.2	11.2	13.2	15.4	19.7	23.2	26.4	21.7	18.6	16.5	16.8	14.8	17.4	16.5
	Average MW	8.5	8.0	9.2	10.5	12.7	14.5	14.8	14.1	12.7	11.0	10.7	9.4	11.3	10.8
1992-93	Peak MW	12.3	12.3	14.5	16.9	21.7	25.4	29.0	23.8	20.5	18.1	18.5	16.3	19.1	18.2
	Average MW	9.3	8.7	10.1	11.5	13.9	15.9	16.3	15.5	13.9	12.1	11.7	10.3	12.4	11.8

TABLE 3-7 (continued)

		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	FY.Av	CY.Av
1993-94	Peak MW	13.5	13.5	15.9	18.5	23.8	27.9	31.8	26.2	22.5	19.8	20.3	17.9	21.0	19.9
	Average MW	10.3	9.6	11.1	12.7	15.3	17.4	17.9	17.0	15.3	13.3	12.9	11.3	13.7	13.0
1994-95	Peak MW	14.8	14.8	17.5	20.3	26.1	30.6	34.9	28.7	24.6	21.8	22.2	19.6	23.0	21.9
	Average MW	11.2	10.5	12.2	13.9	16.7	19.1	19.6	18.7	16.7	14.6	14.1	12.4	15.0	14.3

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, Branch of Power Resources 11/25/74

NOTE: Delivery Point -- Lolo

TABLE 3-8

MID-YEAR POPULATION ESTIMATES

Date	Deer Lodge County	Granite County	Missoula County	Ravalli County
7/1/71	15,800	2,700	59,400	15,100
7/1/72	15,900	2,600	60,700	16,100
7/1/73	15,600	2,700	63,300	17,200
7/1/74	15,300	2,700	65,100	17,600
7/1/75[1]	15,200	2,700	66,500	18,500

SOURCE: U.S. Bureau of the Census, Current Population Report, Federal-State Cooperative Program for Population Estimates, Series P-26.

[1] The 1975 values are provisional only.

a request for similar data regarding the Ravalli County Electric Cooperative (REC), the applicant provided a letter from the REC containing the data given in Table 3-10. From 1970 through 1975, the REC added an average of 166 customers annually, and also experienced an annual average of 63 service improvements. Service improvements were not defined in the letter, and the number of new customers installing electric heating systems was not given. The approximate number of electric heat customers on the REC's system was given as 1,468 of the total 2,605 customers.

TABLE 3-9

MONTANA POWER COMPANY BITTERROOT VALLEY ELECTRICAL CUSTOMER DATA

	12/31/73	12/31/74	12/31/75
Total Customers (Bitterroot Area)	5,986	6,159	6,433
New Electric Heat or Conversions	6	10	31

SOURCE: MPC March 8, 1976.

TABLE 3-10

RAVALLI COUNTY COOPERATIVE DATA

	New Consumers	System Improvements
1970	130	18
1971	178	10
1972	207	114
1973	168	94
1974	162	56
1975	150	85

SOURCE: Ravalli County Electric Cooperative, February 24, 1976.

The fourth factor which will contribute to continued electrical load growth in the Bitterroot Valley according to the applicant is increase sprinkler irrigation pumping. Based upon ". . . recent experience . . ." the applicant estimates that sprinkler irrigation will increase electrical energy consumption ". . . one to two MW per year through 1985" (MPC December 31, 1974). When asked to explain"recent experience",the applicant supplied the past summer peak load data for the Bitterroot Valley shown in Table 3-11. These data indicate an average annual peak summer load growth of about 1.4 MW from 1969 to 1975. The percentage that irrigation pumping loads contributed to the peak load growth was not given by the applicant.

Figure 3-1 maps the study area locations for which beneficial water use applications were filed with the Department of Natural Resources in 1974 and 1975. Table 3-12 summarizes information contained in the individual applications. Sufficient data are not available to estimate the electrical consumption which would result from the proposed water uses.

TABLE 3-11

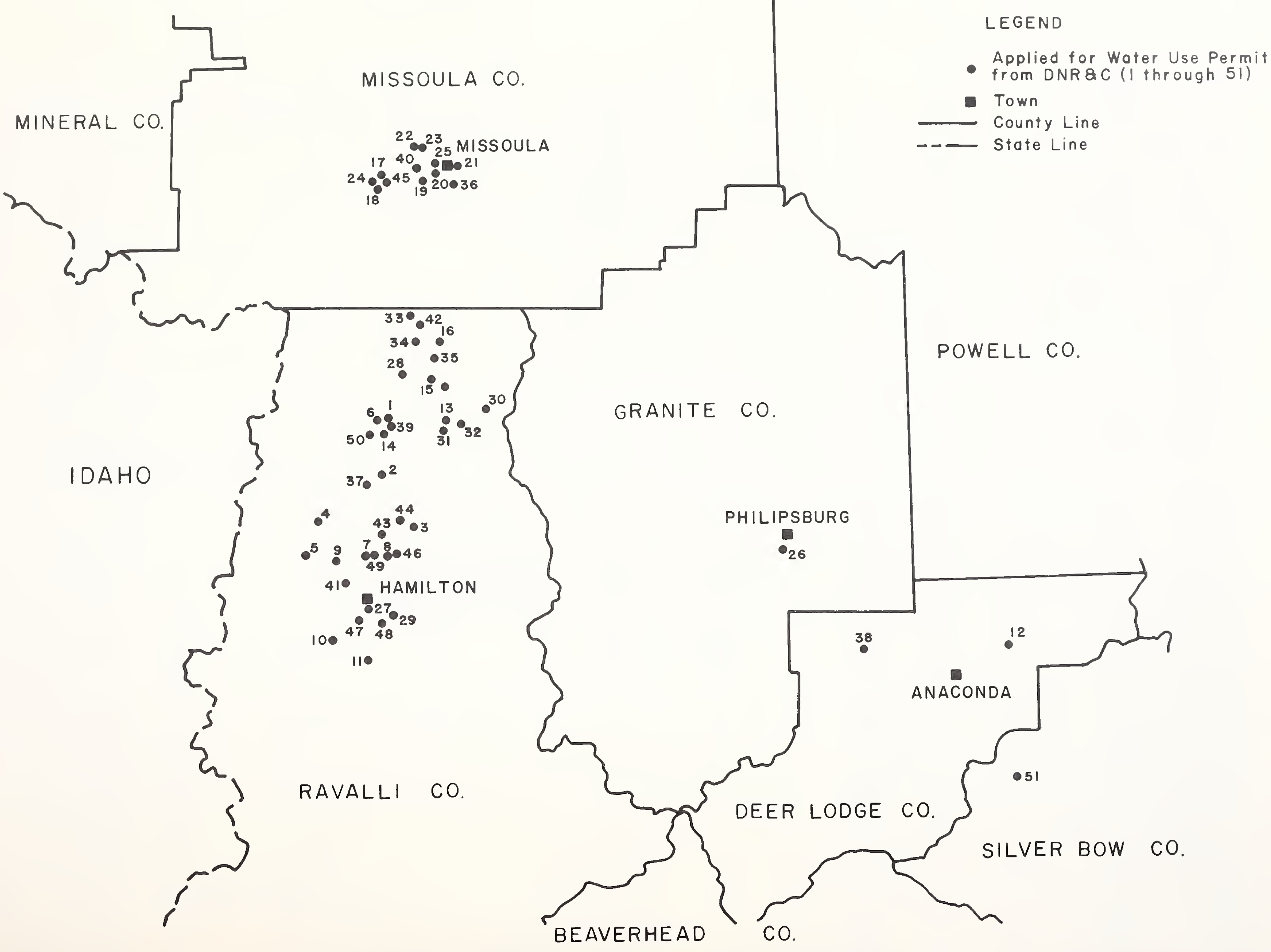
BITTERROOT VALLEY SUMMER PEAK LOADS

Year	Summer Peak KW	Growth from Previous Year KW	MW
1969	16492		
1970	17290	798	0.798
1971	19152	1862	1.862
1972	19950	798	0.798
1973	22078	2128	2.128
1974	23595	1515	1.515
1975	24684	1089	1.089

SOURCE: MPC March 8, 1976

3.3.2.2. Missoula and Philipsburg

In discussing alternative plans and technologies in the Anaconda-Hamilton application, the applicant stated that continued load growth is expected in both the Missoula and Philipsburg areas. Detailed load growth projections and a discussion of the factors contributing to the anticipated load growth in the Missoula area have not been supplied by the applicant. Table 3-8 shows steady population growth from 1971 to 1975 in Missoula County, and Table 3-12 lists seven beneficial water use applications related to irrigation filed during 1974 and 1975 in the Missoula area. Both population growth and increased irrigation pumping can be expected to contribute to the Missoula area's electrical load growth. Table 3-13 lists the applicant's projected Missoula



NEW APPLICATIONS FOR USE-PRIMARILY FOR IRRIGATION

1973-1975

Figure 3-1

TABLE 3-12

APPLICATIONS FOR BENEFICIAL WATER USE PERMITS

Date	#	Name	City	County	T	R	Source	Amount	Description	Purpose	Acres
3/75	1	Theresa Jellison	Stevensville	Ravalli	9N	20W	Bitterroot R. & spring	5 AF 15 AF	Sprinkler Sprinkler	Irr. Irr.	2.5 7 9.5
4/75	2	Glenn Phelper	Victor	Ravalli	8N	20W	Springs & B.R. river	192 AF	15hp pump & pond for wildlife		34
5/73	3	Lawrence Johnson		Ravalli	7N	20W	S.br.Coyote Gulch	75 AF	Pond		30
6/75	4	Richard Randall	Victor	Ravalli	7N	21W	Surface water	3 AF	Pond	Irr.	5
6/75	5	Wayne R. Paul	Corvallis	Ravalli	6N	21W	Springs	5 AF	3' fill dam		
3/75	6	Theresa Jellison	Stevensville	Ravalli	9N	20W	21' well	1 AF	1 hp pump	domestic	
4/75	7	Wayne R. Paul	Corvallis	Ravalli	6N	20W	Pond 3 AF	100 cfs	1 acre pond	wildlife	
4/75	8	Jay M. Gasvoda	Hamilton	Ravalli	6N	20W	Ch. Battea Cr.		storage	Irr.	57.5
6/75	9	Ronald S. Pigman	Hamilton	Ravalli	6N	21W	Tag Allan Lake	12 AF	2'dia.12'deep 1 hp pump culv.	Irr	3
6/75	10	John L. & Nina Portis	Hamilton	Ravalli	5N	21W	Springs	.18 cfs	15'X15' pond 3' high dam	stock & Irr.	40
6/75	11	Stanton Cooper	Hamilton	Ravalli	5N	20W	Sleeping Child Creek			Irr.	130
3/75	12	Ramond J. Johnson	Anaconda	Deer Lodge	5N	10W	Warm Sp.Dr.	9 cfs		Irr.	400
6/75	13	H.K. Peterson & Doris J., Thomas D. & Alice McHarvey	Stevensville	Ravalli	9N	19W	Springs	50 gpm	5hp pump	Irr.	9

TABLE 3-12 (continued)

Date	#	Name	City	County	T	R	Source	Amount	Description	Purpose	Acres
5/75	14	Nathan W. Luibrand	STevensville	Ravalli	9N	20W	McCalla Cr.	132 gpm 5 AF	3 hp pump	Irr.	4
5/75	15	Gary A. Blazich	Stevensville	Ravalli	10N	19W	Springs	8 AF	pond 5 hp pump	Irr	5
6/75	16	Lew W. Cook	Florence	Ravalli	10N	19W	Spring	70 AF	20 hp pump	Irr.	70
1/75	17	James D. & Coy L. Watermire	Missoula	Missoula	13N	20W	O'Brien Cr.	144 AF	10 hp pump pond 150 gpm	Irr.	20
3/75	18	David G. Wright	Missoula	Missoula	13N	20W	Lyon Cr.	10 gpm	gravity flo pond	culinary	2-3
12/75	19	Missoula County Comm.	Missoua	Missoula	13N	19W	well (12" dia. case)	1000 g/mi	Ft. Missoula Park	Irr.	52
12/75	20	Missoula County Comm.	Missoula	Missoula	13N	19W	well (6" dia. case)			domestic use	
5/75	21	MPC	Butte	Missoula	13N	19W	well 150' deep	4839 AF	300 hp pump 300 gpm	municipal	
12/75	22	Robt. L. & Rebecca H. Deschamps	Missoula	Missoula	13N	20W	Marshall Cr.	2 cf/s		Irr.	10
11/75	23	Hellgate Sch. Dist. #4		Missoula	13N	19E	well 8" dia. 50'-90' deep	200 gpm	50 AF		
11/75	24	James D. & Coy L. Waltermire	Missoula	Missoula	13N	20W	O'Brien Cr.	84.25 AF	10 hp pump 150 gpm	dom. & stock	20
9/75	25	Tree Farmers	Missoula	Missoula	13N	19W	well (pump)	400 gpm	8"x80' deep	Irr.	
7/73	26	Phillipsburg (town of)		Granite	7N	14W	well 6"X100'	80 gpm	recreation	Irr.	15

TABLE 3-12 (continued)

Date	#	Name	City	County	T	R	Source	Amount	Description	Purpose	Acres
7/73	27	Jeremy G. Thane D/B/A Valley Water Co.	Hamilton	Ravalli	6N	20W	ground water well	900 gpm	12"X100'	municipal	
3/73	28	Dorris P. Bell & Raztta B. McDuff		Ravalli	9N	20W	3 Mi. Cr.	225 AF 90 Mi. In.	30 hp pump 20' hi. dam	Irr. & domestic	90
9/73	29	Hamilton Golf Club	Hamilton	Ravalli	5N	20W	well ground water	360 AF 376 AF	6"X200' pond 3'-8'	Irr. & Rec.	160
11/74	30	Monica Sobczak	Stevensville	Ravalli	9N	18W	Trb. Amborse Cr.	5 AF	pump 1½" pipe	Irr.	5
12/73	31	Donald F. Pank	Stevensville	Ravalli	9N	19W	Underground water	63 AF	pit, 8' deep (6' wide 7½ hp pump)	Irr.	25
9/73	32	Robert L. Todd, Sr.	Stevensville	Ravalli	9N	19W	ground water	41.5 AF	7½ hp pump	Irr.	9.9
10/73	33	Earl C. Lory		Missoula	12N	20W	Bitterroot R.	33 AF	9½ hp pump 250 gpm	Irr.	11
10/73	34	Harold & Cecelia Morgenstern	Missoula	Ravalli	10N	20W	well 8"X150'	143 AF 200 gpm	pump	Irr.	56
7/73	35	Susie James	Stevensville	Ravalli	10N	17W	ground water	100 AF	150 gpm 10 hp pump	Irr.	20
10/74	36	MPC	Butte	Missoula	13N	19W	well 4.46 cfs	3185 AF	18"X130'	municipal	
10/73	37	Greeta D. Miller	Victor	Ravalli	8N	20W	well	135 AF	48"X10'	Irr.	45
12/73	38	John D. Peterson	Anaconda	Deer Lodge	5N	12W	Foster Cr.	1.5 AF	.0334 cfs	domestic	8

TABLE 3-12 (continued)

Date	#	Name	City	County	T	R	Source	Amount	Description	Purpose	Acres
4/73	39	Norman J. Reinicke	Stevensville	Ravalli	9N	20W	Beaver Cr.	9.2 AF	10 AF pond	Irr.	7
5/75	40	Missoula C. Hi Sch		Missoula	13N	19W	well	50 AF	22 hp pump	Irr.	50
5/74	41	Tom E. Evans & Geo. L. Mangold	Hamilton	Ravalli	6N	21W	.5 AF pond surface water	8 AF	pump 24 gpm	Irr.	2
6/75	42	Maurice G. Foland	Florence	Ravalli	10N	20W	Bitterroot R.	557.5 AF	90 hp pump	Irr.	185
6/74	43	Jacob C. VanEssen	Corvallis	Ravalli	7N	20W	well 4" dia X8' deep	40 AF	7½ hp pump 250 gpm	Irr.	20
7/74	44	David S. Huls	Corvallis	Ravalli	7N	20W	S.Coyote Gulch	.5 cfs 50 AF	10 hp pump 10 AF pond	Irr.	20
8/75	45	David G. Wright	Missoula	Missoula	13N	20W	Lyon Creek	20 AF	gravity feed 60' fall	domestic & Irr.	8
4/75	46	Jay M. Gosvoda	Hamilton	Ravalli	6N	20W	Chief Battee	32.5 MI		Irr.	57.5
4/75	47	Chas. A. Johnson	Hamilton	Ravalli	5N	21W	Springs	60 AF	10 hp pump	Irr.	20
5/75	48	H.J. & Clara Dell Krogh	Hamilton	Ravalli	5N	20W	(2) springs	10 AF		Irr.	3
4/75	49	Wayne R. Paul	Corvallis	Ravalli	6N	20W	Ground water	5 AF	3 AF pond	wildlife	
7/75	50	Dennis H. & Carol A. Barbain	Stevensville	Ravalli	8N	20W	Little Cr. & spring	18" culvert 30 MI	1'X1.5' ditch	Irr.	70
8/75	51	Arthur D. Perterson	Ramsay	Silver Bow	3N	20W	Gergson Cr.	100 AF	pond	Irr.	150

substation peak loads for summer 1976, summer 1979, and winter 1979.

TABLE 3-13

MISSOULA SUBSTATION LOADS

	Missoula #1 100 kV (MW)	Missoula #2 100 kV (MW)	Missoula #3 100 kV (MW)	Waldorf 100 kV (MW)	Missoula Total (MW)
1976 Peak Summer	22.6	23.7	23.6	45.0	114.9
1979 Peak Summer	26.9	28.2	28.0	52.8	135.9
1979 Peak Winter	34.5	39.8	29.1	52.8	156.2

According to the applicant, the Philipsburg area ". . . is experiencing increasing loads particularly in pumping irrigation" (MPC, December 31, 1974). The specific horsepower increases in irrigation pumping from 1971 through 1975 in the Philipsburg area are given in Table 3-14.

TABLE 3-14

PHILIPSBURG IRRIGATION INSTALLATIONS

Year	Installed Horsepower (H.P.)
1971	None
1972	15 H.P.
1973	None
1974	50 H.P.
1975	130 H.P.

During 1974 and 1975 the Department received one application related to irrigation in the Philipsburg area (see Table 3-12).

3.3.3. Load Projections and Projection Methodology

The applicant's projected annual peak electrical loads for the 1976 to 1986 period for all Bitterroot Valley substations and the two Philipsburg substations are shown in Table 3-14.

In making these projections, the applicant does not use the component forecasting method followed by BPA. Although the applicant anticipates that load growth will result from definite factors such as continued population growth, increased reliance on electrical heating systems, and increased irrigation pumping, specific projections for these separate factors or classes are not attempted. The following quote by the applicant explains the methodology used to generate the Table 3-15 data.

> Montana Power Company utilized historical data tempered with experience, judgement and intuition in arriving at load projections for areas such as the Bitterroot. Each substation is carefully analyzed for growth rate based upon historical data.
>
> The load growth rate of a particular substation is found by fitting an exponential curve using the method of Least Squares to a given set of data and then determining from this curve the compound percentage growth rate. The computer program is also capable of projecting the fitted curve out into the future and may be adjusted to pass through the last known load data point. Growth rates may be based upon either all, or a part of the available data.
>
> If a block load has occurred in the history of the substation (i.e., permanent transfer of load from one substation to another) either positive or negative, the program's load growth calculation will automatically compensate for it, if the block load is so noted. Block loads do not affect the load growth but act as a step function off-setting the curve.
>
> These calculations are presently done on the Montana Power Company IBM 370 Computer. In the theory of Least Squares, the line or curve of best fit is that line or curve such that $(y - y_1)^2$ is a minimum where y is the predicted value and y_1 is the actual value.
>
> Assuming the load growth curve is approximately exponential, then it is of the form $y = C\ 3^{bx}$ which is a straight line when plotted on semi-log graph paper, that is, $\ell n\ y = bx + \ln C$ or $\ell n\ y = bx + K$. The substation KW peak demand by year is entered into the computer via punched cards and the theory of Least Squares is used to obtain the best fit to the data. The data is then projected for the future for the individual substations (MPC, December 31, 1974).

TABLE 3-15

ESTIMATED PEAK SUBSTATION LOAD IN KILOWATTS 1976 - 1986

Inst. No.	Substation	76-77	77-78	78-79	79-80	80-81	81-82	82-83	84-84	85-85	85-86
9- 570	Lolo	5080	5334	5601	5881	6175	6484	6808	7149	7506	7881
9- 580	Florence	734	805	882	967	1060	1161	1273	1395	1529	1675
9- 590	Stevensville	2394	2522	2657	2800	2950	3108	3274	3450	3635	3829
9- 610	Stevensville W/BPA	3088	3237	3399	3575	3766	3975	4202	4449	4717	5009
9- 620	Victor	755	757	760	762	765	768	770	773	776	779
9- 639	Grantsdale W/BPA	1426	1469	1513	1558	1605	1653	1703	1754	1806	1860
9- 640	Hamilton City	3172	3259	3347	3437	3530	3626	3724	3824	3928	4034
9- 641	Hamilton Rural	3510	3840	4200	4594	5026	5497	6013	6578	7195	7871
9- 650	Corvallis	1527	1604	1685	1769	1859	1952	2050	2154	2262	2376
9- 660	Darby	7725	7957	8195	8441	8695	8955	9224	9501	9786	10079
9- 690	Lolo W/BPA	4200	4601	5041	5523	6051	6629	7263	7957	8717	9550
9- 730	Corvallis W/BPA	6475	7013	7597	8228	8913	9654	10457	11326	12268	13288
9- 740	Darby W/BPA	4500	4680	4867	5062	5264	5475	5694	5922	6159	6405
1- 360	Philipsburg City	1121	1130	1139	1148	1157	1166	1175	1185	1194	1203
1- 550	Philipsburg Auto	2676	2712	2749	2787	2825	2863	2902	2942	2982	3022

The available historical data, together with the applicant's projected load data for the substations listed in Table 3-15 are given in Tables XII through XXVI in Appendix A.

3.4. Rules and Regulations Governing Transmission System Operation

In any discussion of the electrical need for new transmission lines, the extant rules and regulations governing transmission system operation potentially affecting electrical need should be considered. In the Anaconda-Hamilton transmission line application the applicant makes reference to regulations of the Montana Public Service Commission concerning voltages and voltage variations and to ". . . regionally recognized utility practice and design procedures . . ." in explaining the need for the proposed Anaconda-Hamilton transmission line. The regulations of the Montana Public Service Commission referenced by the applicant are portions of PSC Rule 805. The excerpts included by the application follow:

VOLTAGE STANDARDS
MONTANA PUBLIC SERVICE COMMISSION
EXHIBIT "K"

In exercise of its authority under Montana Law the Public Service Commission has established minimum standards for service. Pertinent excerpts from the regulations approved by the Public Service Commission are found in Exhibit "K".

8-5 Voltages--Utility shall adopt nominal standard alternating current voltages for its entire distribution system, or for each of the several areas into which the system may be divided. Utility shall, upon request from Commission, customer, or prospective customer, furnish a statement of the nominal standard voltages for any specific area. The voltages shall be maintained at a reasonably constant value at any customer's point of delivery, as follows:

a) For service to residential and commercial customers, the voltage variation shall not exceed six per cent plus or minus from the nominal standards within the corporate boundaries of cities and towns having a population of 2500 or more, nor eight per cent plus or minus in all other places.

b) For service rendered primarily for power purposes and for other services rendered under power rate schedules, the voltage shall not exceed ten per cent plus or minus from the nominal standard voltages.

c) A greater variation of voltage than specified above may be allowed when contracts or rate schedules so provide, when service is supplied directly from a transmission line, or in areas where customers are widely scattered, or the revenue does not justify close voltage regulation.

8-6 Voltage Variations--Variations in voltage in excess of those specified shall not be considered a violation of Rule 8-5 if caused by:

a) The large starting current requirements of motors, welders, x-ray machines or other power apparatus on customer's premises.

b) The action of the elements.

c) Infrequent and unavoidable fluctuations of short duration due to operation of utility's system.

The "regionally recognized utility practice and design procedures" are:

> . . . to provide a minimum transmission voltage level of 90% of the nominal voltage at the distribution substation during peak summer load while one transmission line that normally serves that substation is out of service (MPC, December 31, 1974).

It should be understood that this utility practice is not a rule or regulation mandated by the federal or any Montana government agency. The Department is aware of no Montana or federal rules and regulations, other than NEPA, MEPA, PSC Rule 805, and the Major Facility Siting Act, relevant to the electrical need for new transmission lines.

3.5. System Reliability and Problem Service Areas

As noted previously, the three geographical areas mentioned by the applicant in discussing the need for or alternatives to the proposed Anaconda-Hamilton line are the Bitterroot Valley, the Missoula area, and the Philipsburg area. The existing or future electrical system problems in each area are discussed below.

3.5.1. Bitterroot Valley

Load flow analyses conducted by the applicant indicate that continued load growth in the Bitterroot Valley could result in excessive voltage drops at Valley distribution substations in the event of an outage of the Missoula-Hamilton Heights 161 kV line. Assuming such an outage, voltage drops greater than 10% of the nominal voltage would occur at Darby during the projected peak 1976 summer loads, and at Grandsale, Victor, Hamilton, Corvallis, and Darby during the projected peak 1979 summer loads.

In the absence of outages on the existing three Valley transmission lines, no voltage drops exceeding 5% of nominal are calculated for the 1976 or 1979 peak summer loads. The applicant has indicated that the present transmission system, in the absence of line outages, should be adequate to accommodate anticipated load growth without excessive voltage drops at Bitterroot Valley substations through 1995.

TABLE 3-16

LINE OUTAGE DATA

Date	Cause	Service Lost Location	Time
	Bitterroot "A" 69-kV Line		
8-11-74	Truck hit pole	Bitterroot Valley C.K.F. Lumber	42 min. 4 hr. 04 min.
7-17-75	Lightning	Entire Bitterroot Valley	M
7-29-75	Lightning	Victor & Florence Lolo	18 min. 1 hr. 04 min.
	Bitterroot "B" 69-kV Line		
4-11-74	Unknown	Bitterroot Valley	M
4-26-74	Broken crossarm	Bitterroot Valley	M
7-06-75	Lightning	Corvallis & Corvallis R.E.A.	38 min.
	Rattlesnake Sub to Missoula No. 4 Sub 161-kV Line		
7-10-75	Unknown	Entire Bitterroot Valley	3 min.
7-12-75	Extreme High Wind & Lightning	Entire Bitterroot	M
	Hamilton-Heights 69-kV Line		
8-19-75	Lightning	Corvallis & Corvallis R.E.A.	M
	Kerr "A" Line 1973 to 1975 Kerr to Rattlesnake Sub Portion		
5-17-73	Broken crossarm	None	
7-07-73	Crew clearing R/W. Felled tree into line	None	

Table 3-16, continued

		Service Lost	
Date	Cause	Location	Time
	Kerr "A" Line 1973 to 1975 Kerr to Rattlesnake Sub Portion (continued)		
8-13-73	Lightning	None	
12-26-73	Broken crossarm	None	
3-19-74	Broken crossarm	None	
6-19-74	Unknown	None	
7-20-74	Lightning	None	
8-02-74	Logger fell a tree into the line	None	
8-13-74	Lightning	None	
7-01-75	Unknown	None	
7-13-75	Lightning	None	
	Kerr "A" Line Rattlesnake Sub to Mill Creek Sub		
6-29-73	Unknown	None	
8-11-73	Lightning	None	
8-23-73	Lightning	Bonner Sub.	4 min.
1-30-74	Wind and sleet	Bonner Sub.	M
6-20-74	Lightning	Bonner Sub.	M
7-08-74	Lightning	Bonner Sub.	36 min.
7-10-74	Lightning	Bonner Sub.	M
8-12-74	Lightning	Bonner Sub.	M
10-02-74	Unknown	Bonner Sub.	28 min.

Table 3-16, continued

		Service Lost	
Date	Cause	Location	Time
	Kerr "A" Line Rattlesnake Sub to Mill Creek Sub (continued)		
4-27-75	Broken Insulators	None	
5-15-75	Lightning	None	
7-01-75	Lightning	None	
7-03-75	Lightning	None	
7-28-75	Lightning	None	
8-21-75	Unknown	None	
9-09-75	Broken crossarm	None	
11-03-75	Insulators broken with rifle bullets	None	
	Kerr "B" Line 1973 - 1975 Kerr to Rattlesnake Sub Portion		
5-18-73	Relay malfunction	None	
7-17-73	Unknown	None	
6-23-74	Lightning	None	
8-23-74	Tree in the line	None	
9-26-74	Tree felled into line	None	
	Kerr "A" and "B" Lines - Mill Creek Sub to Rattlesnake Sub		
1-18-75	Differential relay action at Mill Creek Sub.	All Missoula Area and Bitterroot Valley	M

Table 3-16, continued

Date	Cause	Service Lost Location	Time
	Kerr "B" Line - Rattlesnake to Mill Creek Sub.		
6-28-73	Unknown	None	
9-06-73	Unknown	None	
1-09-74	Insulators shot with a rifle	None	
2-06-74	Unknown		
2-07-74	Broken static wire; wrapped around phase wire	None	
2-08-74	Unknown	None	
1-19-75	Unknown	None	
1-19-75	Unknown	None	
7-03-75	Lightning	None	
7-13-75	Tree in line	None	
10-10-75	Sleet and ice	None	

SOURCE: MPC December 19, 1975

Historical outage data obtained from the applicant for the transmission lines now serving Missoula and the Bitterroot Valley are given in Table 3-16. No outages of the Missoula-Hamilton Heights 161 kV line are listed. However, construction of this line was completed only in late 1974, and to date the line has been energized at 69 kV. The approximate 1.5 year operating period is insufficient to assess the reliability of this line based upon its outage record to date.

Voltage drops larger than those specified by PSC regulations are predicted to occur in the Bitterroot Valley only during an outage of one or more transmission lines. Because Section 8-6 of Rule 805 exempts voltage variations outside the specified limits during transmission line outages not under the control of the utility, the PSC Rule 805 does not affect considerations of electrical need for the proposed Anaconda-Hamilton transmission line.

3.5.2. Missoula Area

The applicant has stated, "By 1980, The Montana Power Company transmission system without an Anaconda-Hamilton 161 kV line, will be unable to supply the projected power needs of the Missoula area" (MPC, December 31, 1974). Department engineering studies to date do not indicate voltage problems in the Missoula area in the absence of outages on existing lines. Additional analysis by the Department considering the effect of various transmission outages on Missoula area voltages will be completed prior to releasing the final EIS.

The power sources for the Missoula area substations during the projected 1976 summer peak load conditions are given in Table 3-17. This table shows that almost all of the power flowing into the Missoula area enters at the Rattlesnake substation. If outages occur at this substation, significant portions of Missoula and all of the Bitterroot Valley could be without power. Since 1971 one outage has occurred at the Rattlesnake substation. No loss of service resulted in the Missoula area, and the substation was re-energized within one minute (MPC December 4, 1975).

TABLE 3-17

MISSOULA AREA SUBSTATION POWER SOURCES

Missoula Area Substations	Load Supplied MW	Power Source	Transmission Line
Rattlesnake	65.5	Mill Creek Substation	Mill Creek-Missoula 161-kV A & B
	69.0	Kerr Substation	Kerr-Rattlesnake 161-kV A & B
Missoula #1	9.3	Ravena Substation	Ravena-Missoula #1 100-kV

TABLE 3-17 (continued)

Missoula Area Substations	Load Supplied MW	Power Source	Transmission Line
Waldorf	10.5	Alberton Substation	Alberton-Waldorf 100-kV

SOURCE: MPC 1976 Heavy Summer Base Case.

NOTE: Only power supplied to Missoula area substations from sources outside the Missoula area are included. Intra-substation power transfer within the Missoula area is not included.

3.5.3. Philipsburg Area

In discussing alternatives to the proposed Anaconda-Hamilton line in the application, the applicant stated that additional transmission capacity would be needed in the Philipsbrug area to meet continued load growth. However, it should be noted that the applicant did not discuss the Philipsburg area in explaining the need for the proposed line. Subsequently the applicant has stated, "It is estimated that the existing 25 kV and 50 kV lines in the Philipsburg area will require additional voltage support in the year 1979" (MPC, December 31, 1974).

3.6. Summary

In this chapter the various factors potentially influencing the electrical need for the proposed Anaconda-Hamilton transmission line were addressed. Included were discussions of the existing transmission system, the available BPA and applicant load projections, and the extant rules and regulations governing transmission system operation. The applicant has identified three areas as having potential transmission system problems. The applicant argues that two of the areas, the Bitterroot Valley and Missoula, contribute to the need for the Anaconda-Hamilton line. The identified Bitterroot Valley electrical system problem is one of reliability rather than transmission capacity in the absence of line outages. Continued load growth in the Bitterroot Valley could result in low voltages during an outage of the Missoula-Hamilton Heights 161 kV line. Applicant peak load projections indicate that such an outage would result in low voltages initially during 1976 peak summer conditions. Department analyses to date have not substantiated an electrical need at Missoula through 1979, but additional studies will be completed prior to the release of the final EIS.

CHAPTER FOUR

SYSTEM ALTERNATIVES

4.1. Introduction

In this chapter, various alternatives capable of improving or expanding the power systems in the Bitterroot Valley and the Missoula area are discussed. Section 4.2. considers general power generation and transmission methods, including the upgrading of existing facilities or adding new overhead or underground transmission lines. Section 4.3. discussed specific engineering alternatives appropriate to the two areas.

4.2. Alternative Power Supply Methods

The general alternatives for increasing the amount or the reliability of the power supply to a given load center are to: (1) install power generation at the load center, or (2) expand the existing transmission system if power is available from a separate source. These two alternatives are discussed below in reference to the present application.

4.2.1. Local Generation Alternatives

Electric power could be generated at the load centers in the study area from fossil fuels, including coal, natural gas, and petroleum products, and from solar energy and wind energy. However, as discussed below, application of local generation to the system problems discussed in section 3.5. of the previous chapter would result in disadvantages or uncertainties.

Installing 50 MW of local fossil fuel generation to meet the additional load growth anticipated by the applicants through the winter of 1979 in Missoula and the Bitterroot Valley, or to increase system reliability in the Bitterroot Valley, would have economic or availability disadvantages. Complete coal-fired generating systems sized on the order of 50 MW may not be readily available, and they would not be economically competitive with similar sized gas- or oil-fired combustion turbine generators. Also, neither gas nor oil turbines could continuously supply power as cheaply as power could be transmitted from existing hydro or coal-fired generation.

Solar energy and wind energy could be utilized in the study area to reduce the demand for and reliance upon electrical power generated from traditional hydro or fossil fuel sources. The impetus for this reduction would have to come from the level of individual residential or commerical electrical customers because solar and wind systems are commercially available now only to provide power to individual homes and buildings. Solar or wind systems capable of generating electrical power in megawatt quantities are still in the research and development stages. Unless new residential or commercial customers would agree or could be compelled by economics or legislation to install solar or wind energy generating systems, such systems could not be relied upon as practical alternatives to solve specific transmission system problems. Also, because the energy produced by solar and wind systems is not available all of the time, some "back-up" energy source is required. This "back-up" source would generally have to be the utility serving the given area.

4.2.2. Transmission Alternatives

The general alternatives available to increase the amount or reliability of power transmitted from a generation source fall into one of two categories: (1) upgrading the existing facilities, and (2) adding new transmission lines. Alternatives appropriate to each category are discussed below. A third general alternative which could avoid extended periods of low voltages or "brown-outs" during transmission line outages without constructing new lines would involve implementing a load-dropping plan.

4.2.2.1. Upgrading Existing Facilities

The transmission capacity of an existing overhead transmission line can be increased by one of three methods (Harza 1975):

1. Increase voltage and maintain conductor size

2. Increase conductor size and maintain voltage constant

3. Increase both voltage and conductor size

Method 1 requires the alternation of transmission line structures to provide increased insulation levels. A new value of "minimum vertical clearance between conductors at mid-span and ground" must be determined in accordance with the National Electric Safety Code for the increased voltage. To achieve this new value, modification or replacement of existing poles or towers may be necessary. If the existing structures are also used to support other transmission, distribution, or communication circuits, these may have to be relocated to meet safety or operational requirements.

Method 2 can be accomplished by replacing existing conductors with larger conductors, or by bundling a second conductor with each existing conductor. The transmission line structures must be evaluated to determine their ability to withstand the increased mechanical loadings. Also, the hardware by which the conductors are attached to the insulators must be modified or replaced.

Method 3 requires a combination of requirements discussed for methods 1 and 2.

4.2.2.2. Addition of New Transmission Lines

If upgrading the existing transmission system cannot reasonably solve the anticipated load problems, the other alternative is to add more transmission lines. Two basic types of lines are available: (1) direct current, or D.C., transmission lines, and (2) alternating current, or A.C., transmission lines.

Presently, because of economic considerations, D.C. lines are used primarily for large power transfers (more than 1,000 MW) over long distances (more than 400 miles). D.C. lines, therefore, are not a practical alternative for this application.

A.C. transmission lines can transmit power either by underground power cable or overhead transmission lines. The transmission expansion plans proposed by the applicant are all based on the use of conventional overhead transmission lines. This approach is the standard engineering method of dealing with the problems of load growth and reliability. It is also the least costly in terms of first cost, which includes the cost of material, construction, and operation.

The use of underground transmission lines by electric utilities as an alternative to overhead lines has been increasing in recent years. Although the initial cost of underground lines is higher, other factors sometimes make the use of overhead transmission lines unfavorable.

The basic electrical characteristics and estimated cost data relevant to underground transmission obtained from transmission cable manufacturers are summarized in Table 4-1. The estimated cost data indicate that material costs for underground transmission lines can vary from $80,000 per mile to $1,320,000 per mile. Installation costs depend on the length and type of cable involved, the type of terrain, and the distance installation equipment has to be moved. Approximate estimates of installation costs give a conservative value of $400,000 per mile. Installed costs per mile, therefore, for an underground transmission circuit, can vary between $480,000 and $1,720,000. These values are eleven to forty times the applicant's total estimated construction costs of $42,000 per mile for the proposed Anaconda-Hamilton overhead transmission line. Additional discussion of the types of cable available for use in underground transmission and of the applications of each cable type is given in Appendix B.

To determine the engineering feasibility of applying one or a combination of both of the overhead or underground transmission alternatives to solve a specific transmission system problem, the following engineering design steps must be completed:

1. Determine the sections of the route to be replaced by an underground system

2. Determine the length of the sections

3. Establish the technical requirements for substations at the end of the section

TABLE 4-1

BASIC ELECTRICAL CHARACTERISTICS AND ADDITIONAL DATA FOR ALTERNATIVE TRANSMISSION LINE SYSTEM

Manufacturer and type transmission system	Phase to phase rated voltage kV	Effective A.C. resistance at operating temperature ohms/phase/mile	Series inductive reactance at 60 hz ohms/phase/mile	Shunt capacitive reactance at 60 hz ohms/phase/mile	Conductor size kc-mil and material	Cable outside diameter inches	Power rating underground installation MVA	Ampacity	Insulation type	Total losses at full load MW/mile	Estimated material cost dollars per three phase mile[1]
Okonite 3/c Oil Filled Type Cable	115	0.434 @ 90°C	0.2365	7,783	250 Aluminum	3.73	52	261	Paper and Oil	0.0417	\$ 80,000
Okonite 1/c Gas Filled Pipe type cable	115	0.555 @ 85°C	0.308	8,558	212 (4/0 AWG) Aluminum	1.76	46	231	Paper and Nitrogen	0.121	\$ 40,000[2]
Okonite Solid Dielectric 1/c Insulation	115	0.419 @-55°C	0.445	15,772	250 Aluminum	2.7	66	331	Cross-linked polyethylene	0.0786	\$ 156,000
Kaiser 1/c Solid Dielectric Insulated	115	0.294 @ 50°C	0.413	Not Available	350 Aluminum	2.71	58	288	Cross-linked polyethylene	0.0053	\$ 125,000
I.T.E. Imperial compressed SF gas insulated bus	138	0.063 ---	0.105	24,000	4.25 inch dia. tube Aluminum	10.0	240	1,000	SF_6	9.61 kW at 40 MW load	\$1,320,000

SOURCE: HARZA Engineering Company, Chicago, 1975.

[1] Estimated material cost per three phase mile (for budget purpose, not a formal quote) excluding civil works, compensation equipment, and pumping station.

[2] Cost of 5-inch diameter pipe not included.

4. Determine the maximum power which must be transmitted

5. Determine conductor sizes to be considered

6. Obtain electrical characteristics for the alternative transmission system

7. Make the load flow calculations, using an equivalent circuit and the electrical characteristics of the preceding steps, to determine:

    a. The ability to transmit required amounts of power

    b. The ability to operate within acceptable voltage limits

    c. The need for shunt reactors at the sending and receiving end substations

8. Perform calculations if necessary to test the system for stability problems

4.2.2.3. Load Dropping Alternative

In a situation in which two or more transmission lines serve the electrical load of a given area, the outage of one of the lines may result in excessive voltage drops throughout the area. This low voltage condition is commonly known as a "brown-out". A "brown-out" will occur if the capacity of the remaining line or lines is insufficient to accomodate all of the electrical load on the transmission system prior to the loss of one or more lines. Because extended periods of low voltages can damage certain electrical equipment, the loss of one but not all lines may necessitate de-energizing all of lines. For example, the loss of Missoula-Hamilton Heights 161 kV line during the projected peak 1979 summer or winter conditions would result in low voltages at several delivery points in the Bitterroot Valley and would necessitate some action by the applicant to avoid an extended "brown-out".

The potential for an extended "brown-out" could be eliminated by implementation of one or both of the alternatives previously discussed, i.e., upgrading existing lines or constructing new ones. However, an additional alternative may be available which could also prevent an extended "brown-out" without requiring installation of additional transmission capacity. This alternative would involve implementation of a load dropping or load shedding program. If, shortly after the line outage, sufficient load were removed from the transmission system, adequate voltage levels would be restored to serve the remaining load. Load could be removed from the system in a preplanned manner by temporarily dropping customers, as is done in interruptable natural gas service, or by forestalling certain applicatiosn of electrical energy, such as electric water heating, air cooling, and space heating, or by a combination of the two.

Certain specific applications of electrical energy can be controlled directly by the utility through control systems such as radio transmitterreceiver control system or a Ripple Control System. In a radio control system, radio-controlled switches would be installed on customer electrical appliances, such as water heaters, air conditioners, large motors, and other major users of electricity. In the event that the load on a certain portion of the Bitterroot Valley transmission system needed to be temporarily reduced, the switches could be activated by a radio signal sent from one central location, temporarily turning off individual appliances. In a Ripple Control system, similar switches would be installed on individual water heaters, large motors, etc. which would respond to a particular audio frequency pulse injected at a central location such as a substation into the normal 60 hertz voltage signal carried on the transmission system.

The practical problems associated with implementing an emergency load dropping system, including the dollar costs, have not been studied. This alternative would not reduce power outages to ultimate electrical consumers to the extent which the alternatives of adding new transmission lines or new power sources would. However, this alternative would allow planned load reduction to prevent electricity customers from receiving power at unacceptable voltage levels during line outages. An emergency load dropping plan probably could not be implemented with out the cooperation of the Montana Public Service Commission, the utilities, and the affected electric customers. In any case, the implementation of such an alternative would require extensive investigation and public discussion.

4.3. Specific Transmission Alternatives

As discussed in Chapter 3, the applicant has identified three areas, the Bitterroot Valley, and the Missoula and Philipsburg areas, as having future transmission system problems. In explaining the need for the proposed transmission line in the Anaconda-Hamilton application, the applicant made reference to two of these areas, the Bitterroot Valley and the city of Missoula. The future problems of the Philipsburg area were not mentioned in the application except in connection with the alternative plans available to serve the needs of the Bitterroot Valley and Missoula. Regarding Philipsburg the applicant stated:

> . . . the Anaconda-Hamilton 161 kV line as proposed in Plan "A" provides a potential source of power to the Philipsburg, Montana area . . .

No discussion of a substation at Philipsburg to transfer power from the proposed line to the present Philipsburg area transmission system is included in the appropriate section of the application (Section VIII-5, Description of Engineering Design Specifications or Criteria-Substations). Because the Philipsburg area was not represented by the applicant as having a need relative to the present application, alternatives to supply additional power to Philipsburg will not be discussed in this section. Alternatives relevant to the Bitterroot Valley and Missoula transmission system problems will be discussed.

4.3.1. Missoula Area

With respect to the Missoula area, the applicant has stated that the proposed facility is necessary to provide adequate and reliable service. Department analyses to date have not identified voltage drop problems at Missoula substations through 1979 under normal operating conditions (i.e., with no transmission line outages). No electrical need for additional transmission capacity has yet been established. Department studies will be completed and an evaluation made prior to the release of the final EIS.

4.3.1.1. Proposed Anaconda-Hamilton 161 kV Alternative

The applicant's proposed 161 kV line from the Mill Creek substation in Anaconda to the proposed Hamilton Heights substation near Hamilton would provide an additional source of power for Missoula, thereby increasing system reliability. At present, 80% to 90% of the power flowing into Missoula enters through the Rattlesnake substation. Applicant's studies have shown that:

> In the event of an interruption of power flow from Kerr to the Rattlesnake Substation in Missoula or a major outage at the latter substation, approximately 50 MW which is equivalent to 40% of the 1979 summer peak load could be transmitted over this line to Missoula (MPC, December 31, 1975).

The use of the Anaconda-Hamilton Heights 161 kV line as a back-up power source for Missoula would be, however, a short term measure at best. As discussed in section 4.3.2. the Anaconda-Hamilton line would serve electrical loads in the Bitterroot Valley via the Hamilton Heights substation in addition to providing an additional power source to Missoula. In the event of a system outage affecting power delivery to the Rattlesnake substation, the amount of power delivered by the applicant's proposed line to Missoula would depend upon the acceptable voltage level and the power tapped off at Hamilton Heights. As the power requirements of the Bitterroot Valley increase, the power transfer capacity available at Missoula of the Anaconda-Hamilton Heights-Missoula line would decrease. While the Bitterroot Valley load grows, the total load in the Missoula area can also be expected to increase. Consequently the proportion of the total power requirements for Missoula supplied by the Anaconda-Hamilton Heights-Missoula line would decrease rapidly. For example, assuming no increase in the Bitterroot Valley peak load from the summer to the winter of 1979, the 50 MW transferable to Missoula over the proposed 161 kV line would decrease from 40% of the total load in the summer of 1979 to 32% in the winter of 1979. The 32% would be decreased further if the Bitterroot Valley peak load increases from summer to winter as the applicant predicts. Other means of providing back-up to the Missoula area would therefore be required perhaps two to three years after construction of the Anaconda-Hamilton Heights 161 kV line.

4.3.1.2. BPA Tap Alternative

An alternative solution capable of increasing the amount and the reliability of power delivery to Missoula would involve tapping the BPA Hot Springs-Anaconda 230 kV line near Missoula and connecting the new tap to a Missoula substation. Regarding this alternative, the applicant has stated, "If this interconnection was made sooner (than 1980), the problem of an inadequate and somewhat unreliable power supply at Missoula would be solved" (MPC, December 31, 1974). Also regarding a new BPA 230 kV tap, BPA studies have ". . . indicate(d) no great problem in supplying 150 to 200 MW to Missoula if there is no power requirement to the Company at Anaconda" (BPA, December 31, 1975). Connecting the new BPA tap to the Missoula No. 4 substation with a 230 kV line and installing 230/161 kV and 230/100 kV transformers at No. 4 would both create a Missoula power source independent of the Rattlesnake substation and substantially strengthen the existing 100 kV system. The strengthening would occur because by feeding into the 100 kV system at Missoula No. 4 the length of the 100 kV lines interconnecting Missoula substations would be effectively shortened during normal operating conditions, i.e., with both Rattlesnake and Missoula No. 4 feeding into the other Missoula substations.

Load flow cases number 6 and 7 of Table 4-2, which summarizes the results of load flow studies supplied by the applicant and prepared by the Department to date, indicates that the BPA 230 kV tap alternative would result in satisfactory voltage levels under normal operating conditions at Missoula substations through the winter of 1979. Further load flow studies are being carried out.

4.3.2. Bitterroot Valley

The transmission system problem anticipated by the applicant in the Bitterroot Valley involves service reliability rather than a need for additional transmission capacity. As pointed out in section 3.5.1., continued load growth in the Bitterroot Valley could result in excessive voltage drops at Valley substations during an outage of the Missoula-Hamilton Heights 161 kV line. Three alternatives applicable to this potential reliability problem have been identified and are explained below.

4.3.2.1. Proposed Anaconda-Hamilton 161 kV Line Alternative

One alternative for providing increased service reliability in the Bitterroot Valley is the applicant's proposed Anaconda-Hamilton Heights line. This line would increase reliability because it would connect Valley loads to the Mill Creek substation in Anaconda, a power source independent of the Missoula Rattlesnake substation, and because of the additional transmission capacity afforded by a new 161 kV line. The applicant projects that during an outage of the Missoula-Hamilton Heights 161 kV line, the Anaconda-Hamilton line would have sufficient capacity to transmit power to all of the Bitterroot Valley, except the Lolo-Stevensville area, until 1995. The applicant's estimated cost for the Anaconda-Hamilton alternative, excluding substation terminals, is $2,762,500.

TABLE 4-2

LOAD FLOW CASES

Case No.	System Operating Conditions	Missoula No. 1 100-kV		Missoula No. 2 100-kV		Missoula No. 3 100-kV		Waldorf 100-kV		Stevensville 69-kV A		Stevensvill REA 69-kV	
		Load MW	Voltage P.N.	Load MW	Voltage P.N.	Load MW	Voltage P.N.	Load MW	Voltate P.N.	Load MW	Voltage P.N.	Load MW	Volta P.N.
	1976 Peak Summer Loads												
1*	A. System Normal	22.6	103.7	23.7	103.7	23.6	103.8	45.0	102.6	N.A.		1.8	103.0
2*	B. Missoula-Hamilton Hts. 161 kV out	22.6	99.9	23.7	99.8	23.6	100.0	45.0	98.9	N.A.		1.8	96.3
	1979 Peak Summer Loads												
3*	A. System Normal	26.9	100.4	28.2	100.4	28.0	100.6	52.8	99.1	N.A.		2.4	99.1
4*	B. Missoula-Hamilton 161 kV out	26.9	98.6	28.2	98.5	28.0	98.8	52.8	97.4	N.A.		2.4	91.7
	1979 Heavy Winter Loads												
5**	A. Add Anaconda-Hamilton 161 kV	34.5	93.4	39.8	93.3	29.1	93.6	52.8	99.2	1.9	93.3	2.5	92.2
6***	B. BPA 230-kV line tapped; 161 kV from tap to Missoula No. 4; no Anaconda-Hamilton 161 kV	34.5	100.8	39.8	100.0	29.1	100.2	52.8	98.6	1.9	99.7	2.5	98.8
7***	C. Same as case D but Bitterroot Valley load increased beyond 1979 loads to 40 MW	34.5	98.8	39.8	98.7	29.1	98.9	52.8	97.4	2.2	97.1	2.9	96.0
8***	D. Same as case D with 69 kV removed between 9056 + 9059 and between 9059 + 9064; add 161 kV between buses 9041 +9064; previous 69 kV A loads shifted to 69 kV B	34.5	100.6	39.8	100.6	29.1	100.8	52.8	99.2	--		2.5	99.1

Case No.	System Operating Conditions	Hamilton 69-kV		Corvallis 69-kV		Darby 69-kV		Stevensville 69-kV B		Grantsdale 69-kV	
		Load MW	Voltage P.N.	Load MW	Voltage P.N.	Load MW	Voltage P.N.	Load MW	Voltage P.N.	Load MW	Voltage P.N.
	1976 Peak Summer Loads										
1*	A. System Normal	4.4	101.6	6.1	101.3	7.3	99.9	1.5	102.5	1.5	101.1
2*	B. Missoula-Hamilton Hts. 161 kV out	4.4	91.6	6.1	92.2	7.3	89.9	1.5	95.5	1.5	91.3
	1979 Peak Summer Loads										
3*	A. System Normal	5.0	97.8	7.6	97.2	10.6	95.0	1.7	98.5	1.9	97.1
4*	B. Missoula-Hamilton 161 kV out		85.1		85.7		81.9		90.3		84.3
	1979 Heavy Winter Loads										
5**	A. Add Anaconda-Hamilton 161 kV	5.8	92.3	6.6	91.4	13.3	88.6	1.7	91.9	2.4	91.3
6***	B. BPA 230 kV line tapped; 161 kV from tap to Missoula No. 4; no Anaconda-Hamilton 161 kV	5.8	98.0	6.6	97.4	13.3	94.4	1.7	98.4	2.4	97.0
7***	C. Same as case D but Bitterroot Valley load increased beyond 1979 loads to 40 MW	6.8	94.8	7.7	94.0	15.6	90.0	2.0	95.4	2.8	93.5
8***	D. Same as case D with 69 kV removed between 9056 + 9059 and between 9059 + 9064; add 161 kV between buses 9041 + 9064; previous 69 kV loads shifted to 69 kV B	5.8	98.2	6.6	97.6	13.3	94.7	3.6	98.5	2.4	97.3

NOTE: Voltage P.N. means voltage in percentage of nominal.

*Source: MPC, December 31, 1974.

**Source: MPC, 79 HWBC 3.

***Source: Department.

The physical location and design of the Hamilton Heights-Hamilton double circuit 69 kV line would tend to negate the increased reliability afforded to the Bitterroot Valley by an Anaconda-Hamilton 161 kV line. Because the 69 Kv line is located in close proximity to the edge of a road and because two 69 kV lines and one distribution line would be hung on the same single pole structures, the probability of an outage on this line would be greater than that of an outage on the Missoula No. 4 - Hamilton Heights 161 kV line. Any outage repair, maintenance, or pole top inspection requiring the de-energizing on one of the two 69 kV lines would probably necessitate the de-energizing of both lines as the horizontal clearance between the lines is only about three feet. Also, an outage requiring the replacement or splicing of the distribution line conductor would probably require de-energizing both 69 kV lines. The loss of the double circuit 69 kV line between Hamilton Heights and Hamilton would mean that all Bitterroot Valley loads could be served only by the existing Valley 69 kV "A" and "B" lines, the contingency relied upon by the applicant in justifying the need for the Anaconda-Hamilton 161 kV line.

The proposed Anaconda-Hamilton line would also provide a potential power source for the Philipsburg area, although a 161/50 kV substation and some additional 161 kV line would be necessary to connect the Philipsburg area transmission system to the proposed line. In his Long Range Plans submitted to the Department the applicant has identified an alternative plan to serve Philipsburg: a 100 kV transmission line from Anaconda to Philipsburg to Drummond with a substation in the Philipsburg area (MPC 1975 and MPC 1976). As mentioned previously, in the absence of an application to serve need at Philipsburg, no attempt has been or will be made to judge the appropriateness of alternatives to serve Philipsburg.

4.3.2.2. BPA 230-kV Tap Alternatives

Tapping the BPA Hot Springs-Anaconda 230 kV transmission line, as previously discussed in relation to increasing transmission capacity and system reliability to Missoula, would also increase Bitterroot Valley system reliability. Connecting the BPA 230 kV line to the Missoula No. 4 substation would create an additional power source for the Valley independent of the Missoula Rattlesnake substation. In the event of an outage affecting the Rattlesnake substation, power could flow from the BPA line to the Valley via the existing Missoula-Hamilton Heights 161 kV line. Also, given the Missoula No. 4 - BPA 230 kV line interconnection, two alternatives would be available to increase the Valley system reliability by providing additional back-up transmission capacity without building additional lines through urban Missoula to the Rattlesnake substation power source. These alternatives are discussed in turn below.

Transmission capacity equivalent to the present Missoula-Hamilton 161 kV line could be added to the Bitterroot Valley transmission system by constructing a second 161 kV line between the Missoula No. 4 and Hamilton Heights substations on a route paralleling existing lines. According to the applicant, a second Missoula-Hamilton Heights line:

> . . . may have slightly greater reliability (than the proposed Anaconda-Hamilton line) because it would be constructed at a lower elevation and be more accessible, but this is not a major advantage because no reliability problems are anticipated from Anaconda-Hamilton terrain (MPC December 31, 1974).

The applicant has estimated the cost of this alternative to be $4,005,000 as follows:

a) $1,875,000 to tap the BPA Anaconda-Hot Springs 230 kV line about five miles east of Missoula

b) $490,000 to connect that tap to Missoula No. 4 substation with a 161 kV line

c) $1,640,000 to construct a second 161 kV line from Missoula No. 4 to Hamilton Heights following the first line (MPC March 8, 1976)

A second alternative capable of providing back-up transmission capacity equivalent to the Missoula-Hamilton Heights 161 kV line without increasing the number of major lines in the Bitterroot Valley would involve replacing either the existing 69 kV "A: or "B" lines with a new 161 kV line. As shown in the map entitled "Existing Transmission Lines" the 69 kV "A" and "B" lines connect the Missoula No. 4 and Hamilton City substations via routes generally paralleling Montana Highway 93. The "A" line is located to the west of the "B" line. After removal of one 69 kV line, a new 161 kV line could be constructed between Missoula No. 4 and Hamilton City substations along the old "A" or "B" line right-of-way. No cost estimates have to date been developed for this alternative, cut because of the added expense of removing the old 69 kV line (i.e., conductor and poles) and of installing additional transformation at each point at which the 69 kV line is not tapped (5 points on the "A" line and 5 points on the "B" line) between No. 4 and Hamilton, this alternative would be more expensive than building a second Hamilton Heights line as discussed above.

4.3.2.3. Summary

Alternatives appropriate to solving the identified or assumed electrical system problems in Missoula and the Bitterroot Valley have been discussed. They include construction of the applicant's proposed Anaconda-Hamilton 161 kV line, an interconnection of the existing transmission system with the BPA Anaconda-Hot Springs 230 kV line, and construction of a new 161 kV line between the Missoula No. 4 and Hamilton Heights substations. Load flow studies supplied by the applicant or prepared by the Department to date are insufficient to clearly establish superiority of any of these alternatives with respect to Missoula and the Bitterroot Valley. Additional analysis evaluating the impacts of increased loads at Missoula and of outages of lines serving the Missoula and Bitterroot Valley areas will be conducted so that such a determination can be made.

CHAPTER FIVE

ENGINEERING DESIGN CRITERIA/SPECIFICATION

5.1. Introduction

This chapter examines certain engineering characteristics of the proposed facility to be considered for corridor selection. The chapter begins with a description of the proposed facility and its specifications in section 5.2., followed by the proposed construction methods in section 5.3. Section 5.3. also presents cost figures related to the use of helicopters during construction. Section 5.4. addresses electrical characteristics and impact, including problems such as corona and radio interference.

5.2. Description of Proposed Facility and Specifications

The applicant's proposed corridor locations and substation sites are shown in Chapter One. Technical and design data supplied by the applicant are listed below.

Length of Line:

1) Anaconda to Hamilton Heights - approximately 65 miles
2) Hamilton Heights to Hamilton - 5 to 6 miles

Voltage Level: Line 1, 161 kV (161,000 volts)
Line 2, 69 kV (69,000 volts)

Total Right-of-Way Width: 80 feet

Transmission Line Poles:

"H" type structures (see Figure 5-1)
Foundation: approximately 8 feet
No. of poles per mile: 7

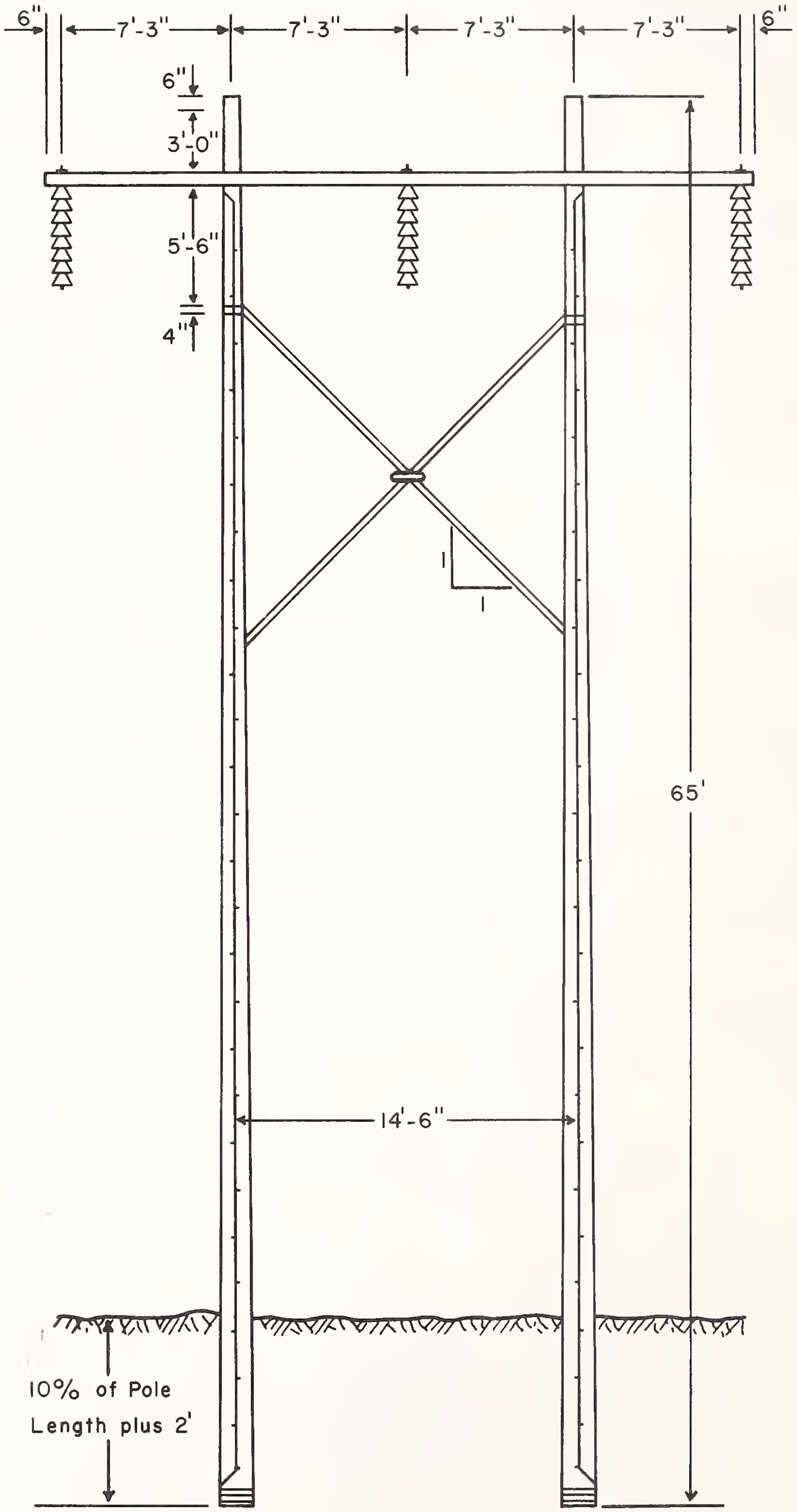
Transmission Line:

Conductor size: 0.927" (556.5 MCM-ASCR)

Thermal capacity and rating: 230 MVA based on conductor temperature at 75°C, air temperature 25°C, wind at 1.4 miles per hour and frequency of 60 hertz

Insulators: 10" diameter, porcelain

Lightning protection system: two 3/8 inch high strength steel strand (7 wire) overhead static ground wires, connected to the ground by one No. 4 AWG copperweld pole ground wire per pole



161 KV LINE SINGLE CIRCUIT STRUCTURE

SOURCE: MPC 1974

Figure 5-1

Construction Cost: $42,000 per mile

Substations:

The substation terminations for the proposed facility are:

Terminal A

Location	Mill Creek Substation
Voltage	161 kV
Type of Termination	Oil circuit breaker
Land Required	Existing substation
Land Ownership	The Montana Power Company

Terminal B

Location	Hamilton Heights Substation (proposed)
Voltage	161 kV
Type of Termination	Oil circuit breaker
Land Required	4 acres
Land Ownership	The Montana Power Company

5.3. Proposed Construction Analysis

5.3.1. General Construction Analysis

The following quote from the application explains the applicant's proposed construction analysis:

> The construction season for most of this line will be limited to the late spring, summer and early fall or a period of time of six months or less. This will influence the construction schedule and make it impractical, if not impossible, to construct the line in one year. Based on the schedule of the following paragraph, the crew size would be approximately:
>
> 1. The right-of-way clearing and road construction crews would require an average of 25 men for seven months. These men would be equipment operators, sawyers and laborers.
>
> 2. The structure and wire installation crews would require an average of 45 men for six months. These men would be equipment operators, linemen, groundmen and foremen.
>
> Timber clearing and road construction, where necessary and permitted, would be accomplished on a major portion of the line during the first construction season (1976). The following year, 1977, these two phases of construction would be completed and structures installed and wire strung on the entire line.

The normal structure installation method will be to assemble the structure on the ground at the structure's site and erect it as a unit with a derrick drawn by a crawler tractor. In certain locations the individual poles will be erected by either equipment on the ground or by a helicopter.

The method of conductor stringing will be to position the conductor reels and pulling equipment on the right-of-way separated by a distance of at least two miles. Pulling lines will be extended from the pulling equipment to the conductor reels. The use of a helicopter in this phase of the conductor stringing will be considered for some sections of the line. Finally, the conductors will be pulled into position by the stationary pulling equipment, then sagged to the proper elevation and clipped to the structures.

Cleanup and restoration of the transmission line rights-of-way will be completed in two separate phases.

The first clean up will be performed as part of the work involved in right-of-way preparation. Old fences will be repaired and new gates provided as required along the right-of-way. Where necessary, culverts and other drainage devices disturbed by this operation will be repaired or replaced to maintain existing drainage patterns and to prevent erosion.

At such time as the structures have been erected and the conductors strung along portions of the line, and construction has been substantially completed so that there is no longer a need for the contractor to move heavy equipment around structure sites and along the right-of-way, a second and similar clean up operation will be performed in and around structure sites, along access roads, and in other areas where damage to the right-of-way might have occurred. Excess materials will be picked up and removed from the site. Structure sites, access roads and other areas will be graded to prevent future erosion. Culverts and other drainage devices will be repaired or replaced as required. Access roads and structure sites will be reseeded with a cover grass indigenous to the area or the landowner will be paid to do the reseeding.

5.3.2. Helicopter Construction

Although seldom used in Montana, helicopters are sometimes used in constructing transmission lines elsewhere. The reasons for using helicopters and the extent of their use on any given line depends on the unique situations of each project. Helicopters can perform most or all of the mechanical work or be limited to delivering poles or crossing rivers with the conductors.

Costs of renting a helicopter crew are on an hourly basis, but many of the functions of transmission line construction can be accelerated to such an extent that the use of helicopters can save money. The costs involved in helicopter construction depend on such factors as the size of the helicopter used, the distance it must be transported, and the efficiency of its use.

Road construction in rugged terrain or through wet areas can be reduced or eliminated by helicopter methods. Fewer roads result in less environmental impact and a cost reduction to the builder. One contractor in Michigan found it economical to use helicopters to distribute poles and cross arms, thus eliminating the need for building roads in an industrial area not far from surfaced roads. Contractors building transmission lines in remote parts of Montana may find it economical to build the lines using helicopters only.

5.4. Electrical Characteristics and Impact Evaluation

The increased use of high voltage transmission lines has brought attention to problems of corona and radio interference (RI). Corona effects have been minized to reduce energy loss but, until recently, have not been considered a serious environmental problem. Radio interference due to corona discharge has become more apparent and important as the number of complaints from citizens has increased. Studies are presently underway to establish acceptable limits of interference. Flashover of insulators, cracked insulator, loose hardware in the tower assembly, and gap discharge cause momentary interference. This is not an important public annoyance at present.

5.5. Communication System

When a power circuit and a communications circuit are in proximity to each other, the power circuit may cause certain inductive or conductive effects which may interfere with the operation of the communications system. This electrical interference may cause extraneous voltages and currents, possibly resulting in damaged apparatus, interrupted service, overheating, noise or acoustic shock in telephone circuits. However, these problems can be eliminated or by a coordinated design minimized of both the power and communications systems.

5.6. Corona

Corona discharge in the air is defined as: "A luminous discharge due to ionization of the air surrounding a conductor caused by a voltage gradient exceeding a certain critical value." At a given voltage, corona is determined by conductor diameter, line configuration, type of conductor, condition of conductor surface, relative humidity, and weather. Rain, more than any other weather condition, increases corona. It causes energy loss through corona up to 20 times as high as that observed during fair weather. In transmission lines with less than 230 kV voltage, corona energy loss is negligible in fair weather.

5.7. Radio and Television Interference

The line conductor configuration, the number of circuits, and the presence of ground wires all affect radiation from the line. Radio and television interference is known to increase as the voltage gradient at the surface of a conductor increases and hence, for a given voltage, is a function of conductor diameter. Radio and television interference is also known to vary inversely with the frequency, meaning that communications using higher frequency bands are less likely to be affected. Directional antennae, which are generally used at higher frequencies, increase signal-to-noise ratios and can therefore mitigate some interference resulting from transmission lines. Finally, radio and television interference is known to decrease as the distance from the line increases. During foul weather (rain, snow, and fog), corona discharge from a 161 kV line can have an effect on radio and television reception depending on signal to moise ratios.

In order to evaluate potential interference of a proposed transmission centerline location, several factors must be known, including the frequency range of existing communications services, the number and type of communication receivers in the vicinity of the proposed line, the proximity of specific receivers to the line, the existing signal strengths, the minimum acceptable signal-to-moise ratio, and the general importance of the various communications systems.

CHAPTER SIX

ENVIRONMENTAL CONCERNS AND IMPACTS

6.1. Introduction

As discussed in Chapter Two, six major environmental concerns were identified for this project:

1. Effects on Aquatic Ecosystems

2. Effects on Land Productivity

3. Visual Concerns

4. Effects on Land Use Patterns

5. Effects on Terrestrial Fauna

6. Socio-Economic Concerns

This chapter contains specific data collected by Department personnel on the six concerns as they relate to the study area. Each section below presents definitions important to an understanding of its concern, a discussion of impacts which may be caused by the proposed transmission line, and mitigating measures to help offset detrimental effects of any of the line's construction phases.

6.2. Effects on Aquatic Ecosystems

6.2.1. Introduction

The study area encompasses portions of five stream systems: the Clark's Fork River, Bitterroot River, Blackfoot River, Rock Creek, and Flint Creek. A variety of habitat ranging from cold, fast-flowing mountain tributaries to lakes and farm ponds is available to the aquatic vertebrate and invertebrate species inhabitating these systems. Of these many species, sport or "game" fish populations attract the most concern. Fishing is a very popular recreation sport throughout the area with an excellent sport fishery characteristic of the streams in general. Rock Creek has an especially productive sport fishery and is classified by the Montana State Fish and Game Commission (1965) as one of Montana's seven finest trout fishing streams.

The well-being of these systems, and the perpetuation of high values inherent in their continued existence is of vital concern in the mitigation of potentially adverse impacts. The following text discusses the major aquatic ecosystem concerns, mitigation methodology, and potential impacts related to the proposed transmission line.

6.2.2. Species of Concern

Aquatic species of concern can be identified as those which are (1) exclusively aquatic and of economical value, recreational value, or unique status, and (2) whose populations are likely to be adversely affected by habitat alteration as a result of construction of the proposed transmission line. Among the fish species found in the study area, the Salmonidae or trout family (Table 6-1 are most highly representative of these criteria. Numerous invertebrate species, as well as several of the smaller non-salmonid fish species (see Table I in Appendix C), are certainly important in the consideration of the overall affect of transmission line related impacts. However, it is reasoned that if the life requirements for the salmonids are met, the requirements for all other important species occupying the same or similar habitats will also be met.

The salmonid populations of the study area are in no danger of disappearing as a result of transmission line-related impacts. The threat lies in the potential for reduction of an already declining amount of productive habitat. For example, poor land management techniques, heavy dewatering for irrigation, and man-made alterations are reducing the amount of productive fisheries habitat available now. Construction of a transmission line through productive sport fish areas can contribute further to the deterioration of important habitat. To help prevent possible adverse impacts, mitigating measures are listed in section 6.2.4.

6.2.3. Geographic Areas of Concern

One of the most important criteria in evaluating the risk for impact to aquatic ecosystems from transmission line-related events is the distance separating the event from the adjacent stream or lake. Since separation distance is ultimately determined by the placement of a centerline once the corridor selection process is complete, it is difficult to consider potential impacts along each stream or lake at the corridor selection level. However, by applying general characterizations to larger areas, such as stream drainages, a broad estimate of each area's sensitivity to potential impacts can be provided. This information can then be used to aid in the selection of a two-mile-wide corridor (assuming random centerline placement) with the least potential impact upon the study area's aquatic ecosystems. For a discussion of the characterizations applied, and their mapping, see section 6.2.5.1.

Despite the necessity of using large areas for the assessment of potential impacts to the area's aquatic ecosystems, there are smaller (site-specific) areas along the streams and lakes that must ultimately be considered in the mitigation process. This can best be accomplished after the tentative corridors have been chosen, as many of the potential impacts affecting these areas can often be effectively mitigated by careful centerline placement.

TABLE G-1

SALMONID FISH SPECIES KNOWN TO OCCUR IN THE AQUATIC ECOSYSTEMS OF THE STUDY AREA

Species[1]	Preferred Habitat	Classif. and Status[2]	Spawning and Movements	Remarks
Lake whitefish (Coregonus clupeaformis)	Deep, cold lakes	G-I	Spawning occurs from October to January. Spawns along shallow shoal areas in lakes.	Restricted to Georgetown Lake. Limited population.
Mountain whitefish (Prosopium williamsoni)	Cold mountain streams, lakes, reservoirs	G-N	Spawning normally occurs in Autumn. Large numbers of fish move upstream to spawn in riffle areas.	The distribution of mountain whitefish is widespread and includes all the major stream systems; migratory populations provide a major winter fishery in many areas.
Kokanee (Oncorhynchus nerka)	Cold water lakes	G-I	Spawning occurs from October to December. Fish congregate in tributaries to spawn.	Restricted to Georgetown Lake. Summer and spawning populations provide a good fishery.
Cutthroat trout (Salmo clarki)	Cold mountain streams and lakes	G-N	Spawning normally occurs from April to July depending on water temperature. Will migrate great distances upstream to spawn.	Distribution of the Westslope Cutthroat trout within the study area, now restricted primarily to tributary streams was once far more extensive than it is today. Loss of favorable habitat, competition from introduced game fish species, and widespread hybridization with introduced rainbow trout has accounted for the decline. Most "cutthroat trout" occurring in the study areas major streams and lakes are now probably Cutthroat Rainbow trout hybrids. Populations of pure strain Westslope cutthroat may now be limited to a few remote basins in the study area. Confirmation of these populations is difficult and knowledge of their extent is unknown, although they may occur in several areas near or along the Skalkaho divide.
Rainbow trout (Salmo gairdneri)	Lakes, ponds, reservoirs, and major rivers	G-I	Spawning normally occurs from April to July depending on water temperature.	Hybridizes readily with Cutthroat trout. Occurs most commonly in the larger portions of the study areas major streams.
Brown trout (Salmo trutta)	Valley portion of large rivers; lakes and reservoirs	G-I	Spawning normally occurs from October through December. Fish in lakes must move into tributaries to successfully spawn.	Excellent growth rates in the larger streams makes it a popular game fish.
Brook trout (Salvelinus fontinalis)	Small spring fed streams or ponds	G-I	Spawning normally occurs from September through October.	Brook trout occur occasionally in the main rivers, but are generally restricted to the tributary systems.
Dolly Varden (Salvelinus malmus)	Larger cold water streams and lakes	G-N	Spawning normally occurs September through November. Breeding sites are in cold headwater streams with clean gravel or rubble bottoms.	Although not considered to represent a major sport fishery, the species is a game fish native to the area.
Arctic grayling (Thymallus arcticus)	Cold mountain streams, lakes, reservoirs	G-I	Spawning occurs normally in spring in mountain streams. Fish in lakes must move into tributaries to successfully spawn.	Limited population, restricted to Georgetown Lake, and Fuse Lake.

SOURCE: Montana Department of Fish and Game.

[1] Nomenclature follows that of Brown (1971)

[2] G-N = Game fish, native to the study area; G-I = Game fish, introduced to the study area.

These areas include important native salmonid spawning and rearing sites which are widespread throughout streams in the upper regions of most watersheds, and the portions of several major tributaries for rainbow and brown trout.

As mentioned in section 6.2.2., aquatic species of unique status are of particular concern. Several limited areas along the Skalkaho divide, such as Deer Meadows and God's Little Acre, may contain populations of pure strain Westslope Cutthroat trout. These relict populations, once far more extensively distributed throughout the study area, are difficult to confirm and their extent remains unknown. Centerline placement to avoid areas thought to contain these populations would reduce the possibility of adverse impacts.

6.2.4. Potential Impacts and Mitigating Measures

Transmission line construction can cause or aggravate the following types of major aquatic impacts:

(1) sediment and sedimentation
(2) alteration of streamflow
(3) organic debris
(4) increased water temperatures
(5) sanitary waste and toxic material

Most of these impacts result from road building and other construction-related activities; impacts resulting from preconstruction, operation, and maintenance phases are expected to be minor. The following pages contain detailed discussions about the impacts listed above, including definitions, causes, and mitigating measures.

6.2.4.1. Sediment and Sedimentation

Sediment and sedimentation result from the transport of inorganic material (clay, silt, and sand) into water. Sediment is inorganic material suspended in water; sedimentation is suspended solids which have settled on or within the streambed. The potential for inorganic material to become sediment is determined largely by many things, primarily slope, distance separating a disturbance from surface water, erodibility of the soil, rainfall, and vegetation. Certain transmission line-related activities promote conditions conducive to sediment and sedimentation; they are described below.

I. Sources of Sediment

I.A. Construction of Access and Maintenance Roads

Road construction will be required for access to and maintenance of the proposed transmission line. If not property constructed, roads can ultimately result in the direct disturbance, through erosion and sedimentation, of a much larger area than is involved in the transmission line right-of-way.

Road location is especially important. The risk for sediment and sedimentation is high when road construction occurs adjacent to a stream or must cross a stream. Also, steep mountainous areas with erodible soils are susceptible to soil mass movement and landslide erosion, the major sources of excessive sediment in aquatic systems (Fredriksen 1972, Swanston 1970). Roads through such areas often provide the triggering mechanism for mass movements because cut slopes remove downhill support for unstable soils. Other road construction activities are potential sediment and sedimentation producers. For example, inadequate placement and maintenance of culverts may add to the risk by channelizing flows for large sections of road and creating gullies in easily erodible fill slopes.

I.B. Movement of Heavy Equipment

Erosion is the most serious problem which may be caused by equipment involved in site preparation and tower erection. Movement to and from construction sites by the equipment may lead to breakdown and damage to existing and new access roads, resulting in erosion on areas of steep slope and erodible soils. This condition may be compounded by road use during wet conditions, as ruts generated by travel in steep areas provide effective means for the channeling and rapid transport of inorganic material.

It may be necessary, also, for vehicles and equipment to ford streams while traveling in the right-of-way. This may contribute to sediment production through direct disturbance of the stream bottom and breakdown of the stream banks.

I.C. Removal of Vegetation

Tower site preparation areas and large cleared areas, necessary for maneuvering equipment, reduce plant cover and may increase sediment yield. A cover of trees and other vegetation tends to stablize soil and minimize the transport of inorganic material. Its removal, particularly from steep slopes or near stream channels along the right-of-way, may lead to erosion and increased sediment and sedimentation in the stream systems.

II. Effect of Sediment and Sedimentation on Aquatic Ecosystems

The occurrence of sediment in rivers and lakes is a natural phenomena, and, as such, is not inherently negative. On the contrary, its geologic origin, physical and chemical characteristics, sources, and concentration have helped to shape watersheds and determine which aquatic organisms live within them. These organisms have subsequently become selectively adapted to a set of environmental parameters characteristic of these watersheds and are very sensitive to changes in those parameters. Man's activities in these areas have the potential to place an additional burden or stress, in the form of increased sediment and sedimentation, upon these organisms. Their survival is dependent upon the extent of increased sediment and sedimentation, the resiliency of the organisms, and the effectiveness of mitigation measures. Following is a discussion of the effects of sediment and sedimentation upon aquatic insects and fish.

II.A. Aquatic Insects

Aquatic insects provide a major food source for populations of salmonid fish species occurring in the study area. A change in aquatic insect populations great enough to represent a major loss of the food supply to salmonids could seriously affect the productivity of the salmonid populations.

Among the major causes of aquatic insect mortality associated with sediment are: (1) its abrasive action, (2) the clogging of delicate external gill systems by suspended sediment, (3) egg mortality, and (4) the smothering of relatively non-motile forms by the deposition of sediment. The threat is greatest in the rubble substrate, as it is most productive for bottom organisms desirable as food sources for fish populations. When stream conditions permit the accumulation of sediment (sedimentation), the interstices of rubble substrate are filled. Those insects more adapted to the sedimented habitat become established, replacing forms that are a source of food for fish. The new forms are generally burrowing, smaller, and less accessible as a food supply for fish than those forms typifying the non-sedimented habitats.

Most authors agree that if sedimentation is short-term, localized, and not excessive, aquatic insect populations will return to the presedimentation densities and diversities through recolonization of the affected area by immigration of populations from unaffected upstream areas. It is doubtful, however, that rapid recovery would occur if an entire watershed were subject to the effects of prolonged sedimentation (Bjornn *et al*. 1974, Hynes 1970, Cordone and Kelly 1961, Tebo 1955).

II.B. Fish

Sediment affects fish directly by reducing visibility, limiting the ability of the fish to locate food sources, clogging of gills by particulate matter, and abrading external structures by the action of suspended solids (Phillips 1970, Saunders 1967, Chapman 1962). The extent and magnitude of these impacts are dependent upon many variables, including species, age, and general health of the fish affected, water quality, the length of exposure to sediment, sediment particle size, shape, hardness, and frequency of particle introduction.

Most authors conclude that concentrations of suspended solids must be very high to cause direct mortality of fish; in most cases, indirect damage to the fish population through destruction of the food supply, eggs or fry, or changes in the habitat probably occur long before the adult fish are directly harmed. Mortality of fish eggs caused by sedimentation is well-documented (Elser and Marcoux 1971, Saunder and Smith 1965, Bianchi 1963). Clean permeable gravels provide nursery areas for fish embryos in the stream environment. Sediment in the water during the incubation period can greatly reduce the survival rate of developing embryos by clogging the pore spaces between the gravels. The supply of oxygen necessary for successful embryo survival diminishes, resulting in high embryo mortality (Peter 1962).

After hatching, fish fry depend on the crevices and interstices in the gravel along the stream bottom for cover and security from predators. Sedimentation can fill these spaces, eliminating escape cover. Phillips (1970) suggests that this increased vulnerability to predators may contribute to increased fry mortality.

Adult fish populations can be seriously affected when sediment accumulation fills important pool areas, reducing available cover and hiding places (Saunders and Smith 1965). Bjornn et al. (1974), working in Idaho, concluded that the summer, and probably the winter, capacity of small mountain streams, where most trout reside in pools, will be reduced if sufficient sediment is added to a stream to reduct pool area or volume.

Habitat lateration caused by sediment and sedimentation will, for the most part, be short-term, occurring during and immediately after construction activities. However, if the physical characteristics of a stream limit the ability for sediment removal through the normal flushing action of seasonal spring flows, habitat alteration may be of a longer duration.

III. Mitigating Measures

Sediment and sedimentation caused by transmission line-related construction activities can be reduced by:

(1) Using existing access roads where possible

(2) Using helicopters in sensitive areas and limiting new road construction

(3) Designing new roads and upgrading existing roads to adequately accommodate the largest and heaviest piece of machinery involved in construction

(4) Reducing road grades wherever possible

(5) Installing cross-drainages in roads with erodible soils and steep grades

(6) Providing a natural vegetation buffer between roads and streams

(7) Locating roads to avoid headwalls at the source of drainages, since these are often unstable slopes

(8) Restricting wet-weather road construction, particularly on poorly-drained erodible soils

(9) Prohibiting disposal of excess fill material within the high-water zone of streams

(10) Routing surface road drainage onto the forest floor, preferably on benches so that sediment can filter out

(11) Avoiding roads that parallel streams

(12) Placing roads to minimize the number of stream crossings

(13) Avoiding roads in marshes, bogs, and other areas of extreme wetness

(14) Restricting road access after the line construction is complete

(15) Revegetating with species mixture recommended on Table 6-3 in section 6.3

(16) Avoiding placement of tower sites on areas with erodible soils, or sidehills and narrow ridge-tops

Where road placement necessitates the direct disturbance of streams, sediment and sedimentation can be greatly reduced by:

(1) Approaching and crossing at right angles to the stream to minimize streambank damage

(2) Installing culverts or arch bridges at major stream crossings or those with importance to the fisheries of the drainage

(3) Using culverts with sufficient capacity to carry the largest streamflow expected

(4) Avoiding direct use of stream bottom or bank material as a source of construction material

(5) Avoiding work within or adjacent to streams during periods of high streamflow, intense rainfall, or migratory fish spawning

(6) Removing excess floatable debris from areas immediately above crossing to prevent culvert obstruction during high waters

Sediment and sedimentation caused by removal of vegetation associated with the right-of-way clearance can be reduced by:

(1) Positioning right-of-way to avoid the necessity of excessive clearing on steep slopes with erodible soils

(2) Avoiding any excessive clearing in areas adjacent to stream channels

If clearing involves removal of marketable logs, sediment can be minimized by:

(1) Avoiding use of stream channels for skidding of logs

(2) Avoiding the falling of trees into or across streams

(3) Locating log landings away from stream channels

(4) Yarding logs uphill and away from any stream

Sediment and sedimentation caused by the movement to and from construction sites by large, heavy equipment can be minimized by:

(1) Improving existing access roads to prevent road failure

(2) Restricting use of roads during wet conditions

(3) Minimizing movement within the right-of-way

(4) Avoiding any off-road travel with equipment, especially the fording of small streams

6.2.4.2. Streamflow

The removal of a large amount of vegetation from a watershed can substantially alter existing streamflow patterns (Rothacher 1972, Hibbert 1967). An alteration of streamflow, whether as an increase in peak flows or a decrease in minimum flows, has been known to affect fish populations (USFS 1973, Hynes 1970), particularily if the flow alteration takes place during critical times, such as spawning, egg hatching, and fry rearing. Alteration of existing streamflow may be greatest where right-of-way clearance necessitates the removal of a large amount of vegetation in small, steep, mountainous watersheds with numerous small streams or springs.

The majority of documented studies of streamflow alteration has involved the disturbance of larger areas within watersheds than is anticipated with the proposed transmission line construction. It is anticipated that any alteration of streamflow that may occur as a result of the proposed action will be insignificant.

6.2.4.3. Organic Debris

Organic debris consists of the tops, limbs, leaves, bark, and nonmerchantable logs or trees cleared for right-of-way or road. If the debris is allowed to collect in streams, a debris jam or series of jams may cause difficult passage at certain water levels for migrating salmonids (Narver 1970), and may prevent successful spawning by the fish inhabiting the stream.

Debris jams can affect fish production by means other than physically blocking the stream. Debris, ranging from single logs to large jams, causes instability of the stream ben, particularly if the debris shifts position with high flows (Helmers 1966). Relocation of gravel associated with shifting of debris has been known to result in high salmonid embryo and fry mortalities (McNeil 1966). Another result of such gravel shifts may be the temporary reduction of bottom fauna (Narver 1970).

Logging debris (particularly leaves, small branches, and bark), when introduced into a stream, can cause a change in the dissolved oxygen content of the water, resulting in a marked oxygen decrease in both the gravel and surface waters. This could affect salmonid survival, particularly in small shallow streams during low summer flows when the fish are restricted to pool areas.

The risk for introduction of organic debris into the stream systems of the study area can be reduced by:

(1) Restricting vegetation clearance in areas adjacent to or in flood plains of stream systems

(2) Avoiding large, continuous areas of heavy slash, particularly in stream flood plains

(3) Avoiding the falling of trees or brush into or across streams

(4) Hand-clearing all sections of stream directly affected by the right-of-way clearance or road construction

(5) Proper disposal of road-building debris

(6) Encouraging full utilization of slash

(7) Retaining an adequate buffer strip of vegetation between stream and disturbance zones

6.2.4.4. Increased Water Temperatures

Excessive removal of vegetation cover from beside small streams, as for right-of-way clearance, may increase the maximum water temperature experienced in the streams (Fredriksen 1972, Brown and Drygier 1967). Increased maximum temperatures may cause mortality, particularly of fish in juvenile and embryonic stages; however, the major effects are probably reduced growth, vigor, and resistance to disease (Fredriksen 1972).

The risk for increased water temperatures, or thermal pollution can be minimized by:

(1) Retaining adequate stream buffer strips of native vegetation between roads or right-of-way and the stream system

(2) Minimizing undergrowth disturbance

(3) Avoiding excessive vegetation removal adjacent to the stream

6.2.4.5. Sanitary Waste and Toxic Material

Improper location of sanitary facilities can cause excessive bacterial concentrations in the water. Also the accidental discharge of fuels, waste oils, and other toxic materials into streams can deteriorate water quality and cause fish kills.

6.2.5. Mapping and Rating

The following discussion presents the methodology involved in the construction of base maps and the final composite map used in identifying areas of greatest potential transmission line-related impacts to the study area's aquatic ecosystems.

6.2.5.1. Base Maps

I. Units of Concern

Boundaries of the major stream drainages and their sub-drainage units were drafted on a base map prepared at the scale of 1:250,000. The drainage units were grouped into five categories based upon: (1) suitability as spawning and rearing habitat, and (2) existing sport fishery. Each category was given a subjective rating from 0-10; zero representing the rating of least value, ten representing the rating of highest value (Table 6-2). Information used to categorize and rate the units was obtained from USFS and MF&G stream and lake surveys, personal communication with biologists from these agencies, and field investigation. Fisheries data for many of the smaller streams were not available, necessitating a broad estimation in several cases. Drainage units of like rating were combined, producing the final "Aquatic Ecosystems Units of Concern" map. The map provides an estimate of each unit's relative value as it applies to the well-being of the study area's sport fishery.

II. Erodibility Hazard

The erodibility hazard map was drafted from information provided by the USFS Region I soil scientists as part of a Land System Inventory Sub-section level map, including delineation and characterization criteria of the sub-section level mapping units and power line corridor interpretations. The Land System Inventory map of the sub-section level consists of very broadly defined associations that are useful in large area planning. The mapping units represent area sized ranging from 10's to 100's of square miles. Data about each mapping unit's geologic setting, landform, elevation, soils, climax vegetation, and water (physical form) form the criterion for unit characterizations.

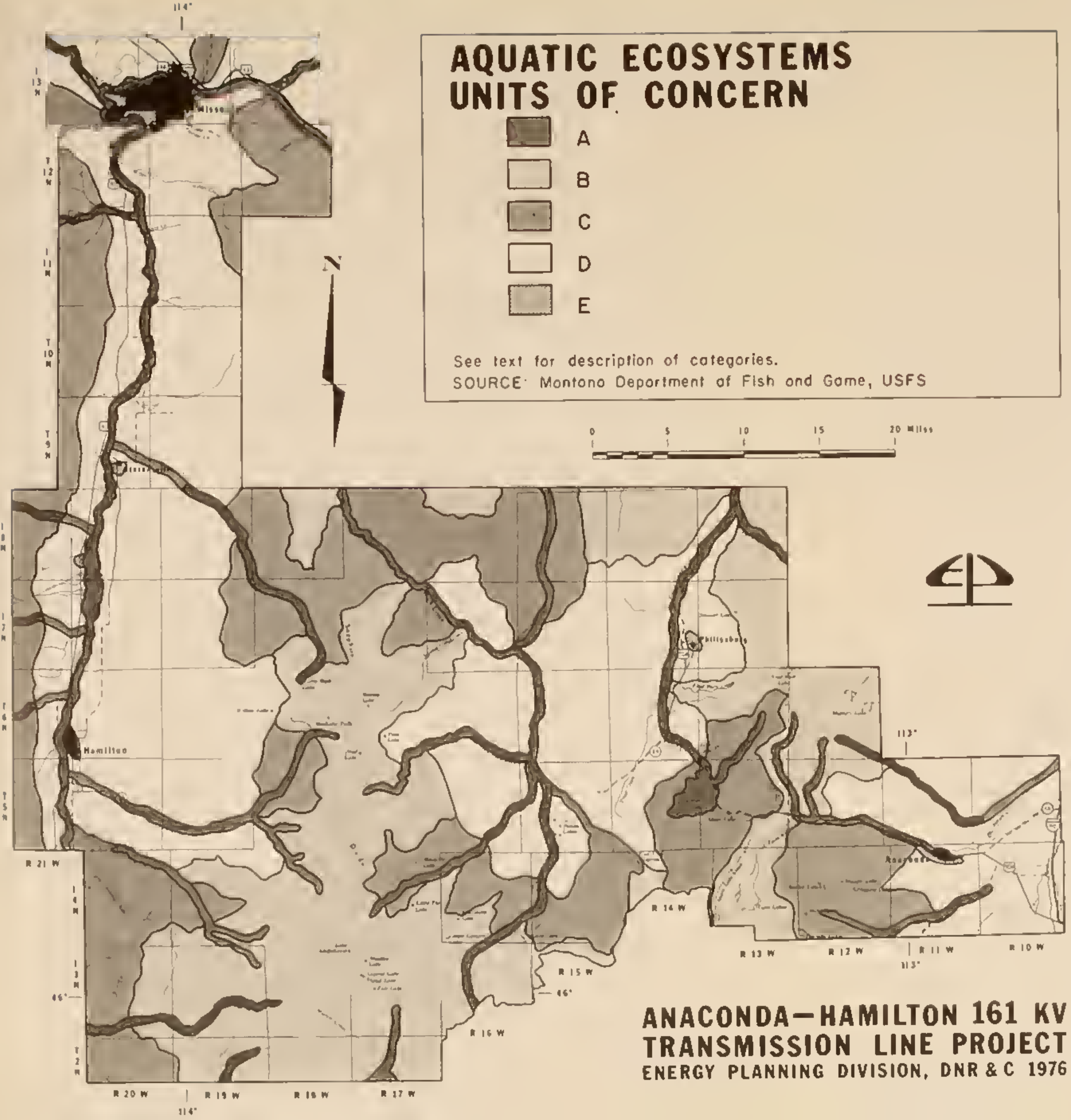
Interpretations have been made by USFS soil scientists for each Land System Inventory unit concerning its power line corridor erodibility hazard. The classes of interpretations are as follows:

Slight:	Limitations can be overcome by normally applied practices. No special treatment required.
Moderate:	Limitations can be overcome by special design, location or practices which are available but

TABLE 6-2

AQUATIC ECOSYSTEMS "UNITS OF CONCERN" CATEGORIES AND THEIR RATINGS

Drainage Unit Characteristics	Category and Rating
Streams and lakes included in these units are recognized as having an important sport fishery (note: the 1965 classification of streams in the study area by the Montana State Fish and Game Commission is being revised at this time and was used only as a guide in this study). A one-quarter mile wide unit boundary is designated on the map along each side of these systems. These units generally define the areas adjacent important systems along which the greatest risk for direct disturbance to the stream may originate. The lower portions of most tributaries to these systems that may offer suitable spawning habitat for migrating sport fish species are included within the unit boundaries.	A (10)
Most streams and lakes in these units provide a major source of water and suitable spawning and rearing habitat for important resident or downstream sport fisheries. Fisheries in these areas may be good to marginal; however, in many drainages remains largely unknown.	B (8)
Larger streams within these units may offer limited spawning habitat for sport fish migrating from major streams or lakes. Resident fisheries generally marginal or unknown. Includes valley portions of larger streams. Most of these streams are heavily dewatered along these units for irrigation or have deteriorated sport fish habitat caused by overgrazing, bank trampling, etc. Fisheries are very limited or marginal in most cases.	C (4)
Units with small streams, generally of less fisheries importance than those in category C, many of which are intermittent. Fisheries are very limited, or unknown. Includes valley areas or benchland dissected with numerous small intermittent streams and/or irrigation diversions. Fisheries in these areas are limited, dependent on localized conditions for improved habitat.	D (2)
Urban areas and small communities.	E (0)



AQUATIC ECOSYSTEMS UNITS OF CONCERN

■ A
□ B
▩ C
□ D
▨ E

See text for description of categories.

SOURCE: Montana Department of Fish and Game, USFS

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not normally used; suitable for the use, but at additional cost.

Severe: Limitations are difficult and/or costly to overcome. Either technology is not available to overcome the limitation, or it is extremely costly to apply. The land should not be allocated to the use unless there is no alternative.

The Department assigned a subjective rating from 1-10 to each class. Subsection units of like rating were combined to produce the final "Erodibility Hazard" map

III. Slope

One of the determinants of erodibility is the slope of the surface upon which a given activity is performed. In the case of transmission lines, the slope determines also the amount of road building necessary to construct the line (except where helicopters are used). The amount of roads built subsequently contributes to the risk for sediment and sedimentation in the area's aquatic ecosystems.

Uniform topographic coverage of the study area exists at a scale of 1:250,000 on a topographic map series (sometimes referred to as the AMS series). The Department contracted with the U.S. Geological Survey Topographic Division to produce slope maps from the existing Butte, Dillon, Hamilton, and Elk City two-degree maps. The technique involves an optical-mechanical system which can be used on the plates of a published topographic map.

Four slope zones were selected:	Erosion rating
1. 0-10%	1 (low-moderate)
2. 10-30%	3 (moderate-high)
3. 30-45%	5 (high-very high)
4. above 45%	10 (severe)

Each zone has been given a subjective erosion rating by the Department.

6.2.5.2. Composite Map

Sediment and sedimentation, as discussed in Section 6.2.4.1., are the transmission line-related impacts of most concern when considering impact to the area's aquatic ecosystems. Combination of the "Erodibility Hazard," "Slope" (contained in the back pocket), and "Aquatic Ecosystems Units of Concern" base maps produces a composite map that can provide a general estimate of the potential for transmission line-related sediment and sedimentation impacts. This composite map is entitled "Aquatic Ecosystems Composite." The subjective base map unit ratings occurring in each new composite map unit are summed via computer, according to the following formula:

(Slope) + (Erodibility Hazard) + 2(Units of Concern) = Summed Value

Since the potential for an impact to have a serious affect upon a stream or lake is largely determined by the importance of the existing habitat, the Units of Concern ratings are given a double (2x) weighting to reflect this factor. The summed values are scaled from 0 - 4 as shown below:

Summed Value	Scaled Value	Impact Category
33-40	4	Severe
28-32	3	Large
19-27	2	Moderate
10-18	1	Slight but significant
2-9	0	Zero or negligible impact potential

A "Composite Aquatic Ecosystems" map is produced, each unit containing a value of 0-4 representing a corresponding impact category. These scaled values and impact categories for each map unit are the primary criteria for the aquatic ecosystems in the corridor selection matrix.

Parameters used in the construction of the composite map are broad, and are designed to reflect only the general characteristics of large areas useful in the selection of tentative two-mile-wide transmission line corridors. Each unit may, regardless of its scaled value, contain site-specific areas of higher potential impact. However, since these areas are usually small and can often be avoided when placing a corridor centerline, they are not considered in corridor selection.

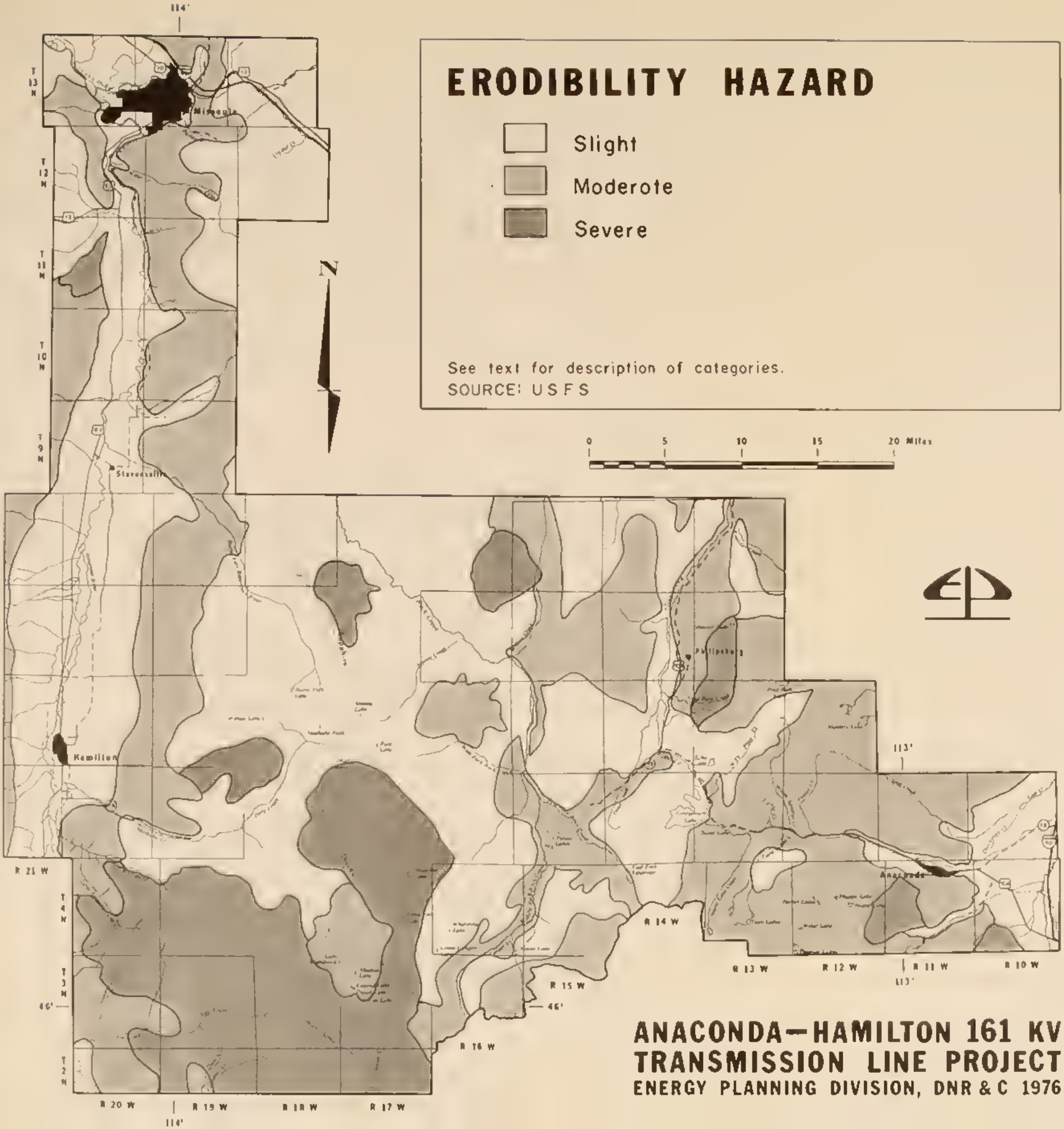
6.3. Effects on Land Productivity

6.3.1. Introduction

In an increasingly urban society, it is difficult to keep in mind that food and lumber come from the land, and not from the supermarket or lumber store. Plants, the source of food and fiber, are an important renewable resource in the study area. While the utilization of these plants changes with technology, the productive base is of enduring value. Growing population and dwindling energy supplies are now reaffirming the importance of the productive base for renewable resources.

Plants are important not only as a raw material; they are essential to nutrient cycling, oxygen production, wildlife, and aesthetics. However, methods of comparatively evaluating vegetation in respects other than production and economic use are relatively few, owing to the complexity of ecosystems and the difficulty of obtaining and assimilating data for a large area. Comparative productivity is one valid way of taking plants and site into account for impact evaluation.

The fundamental resource involved in productivity is site quality, the sum total of all the factors affecting the capacity to produce vegetation (Spurr 1973). In this section, productivity has been measured in utilitarian



See text for description of categories.
SOURCE: U S F S

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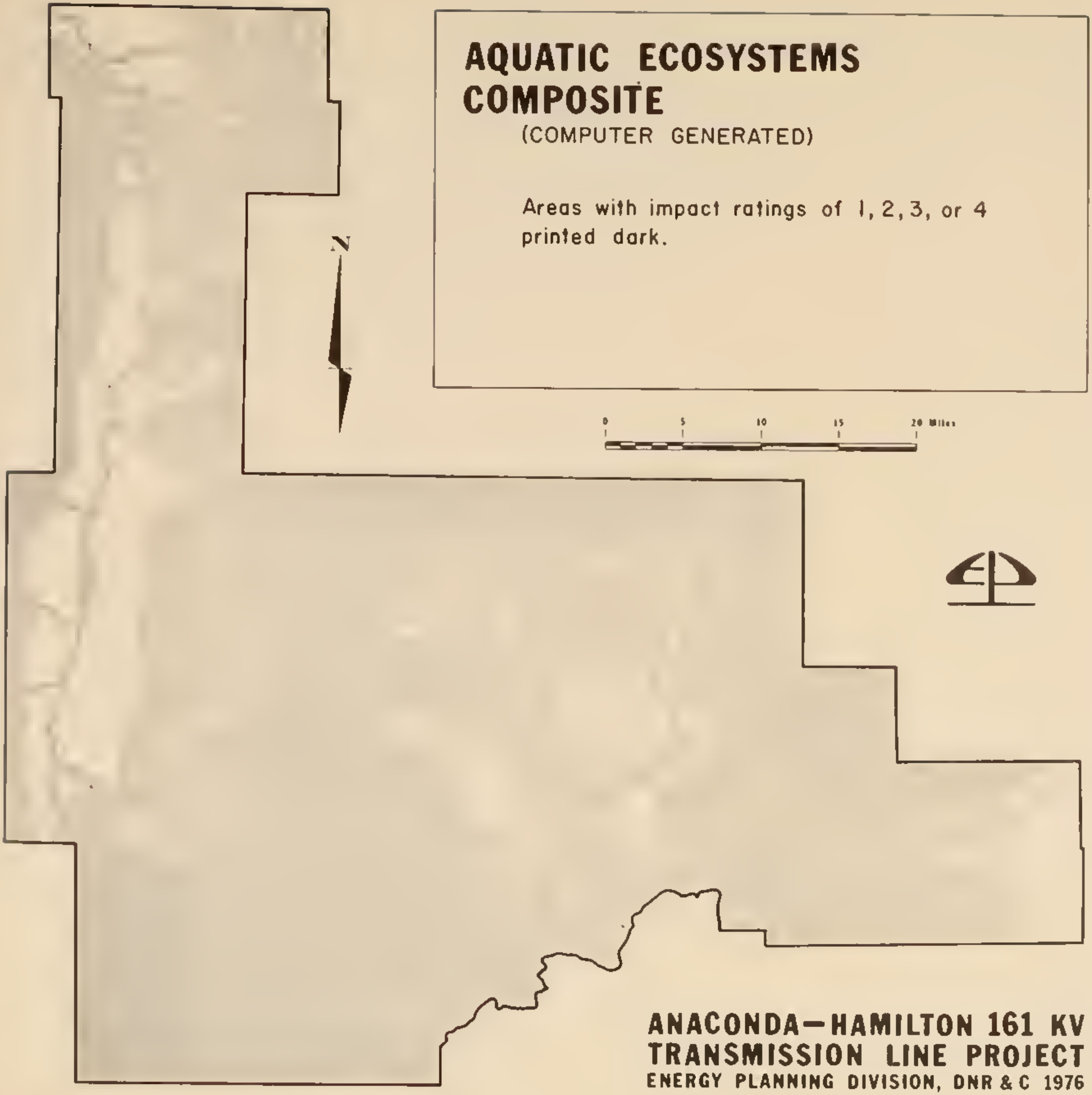
AQUATIC ECOSYSTEMS COMPOSITE

(COMPUTER GENERATED)

Areas with impact ratings of 1, 2, 3, or 4 printed dark.



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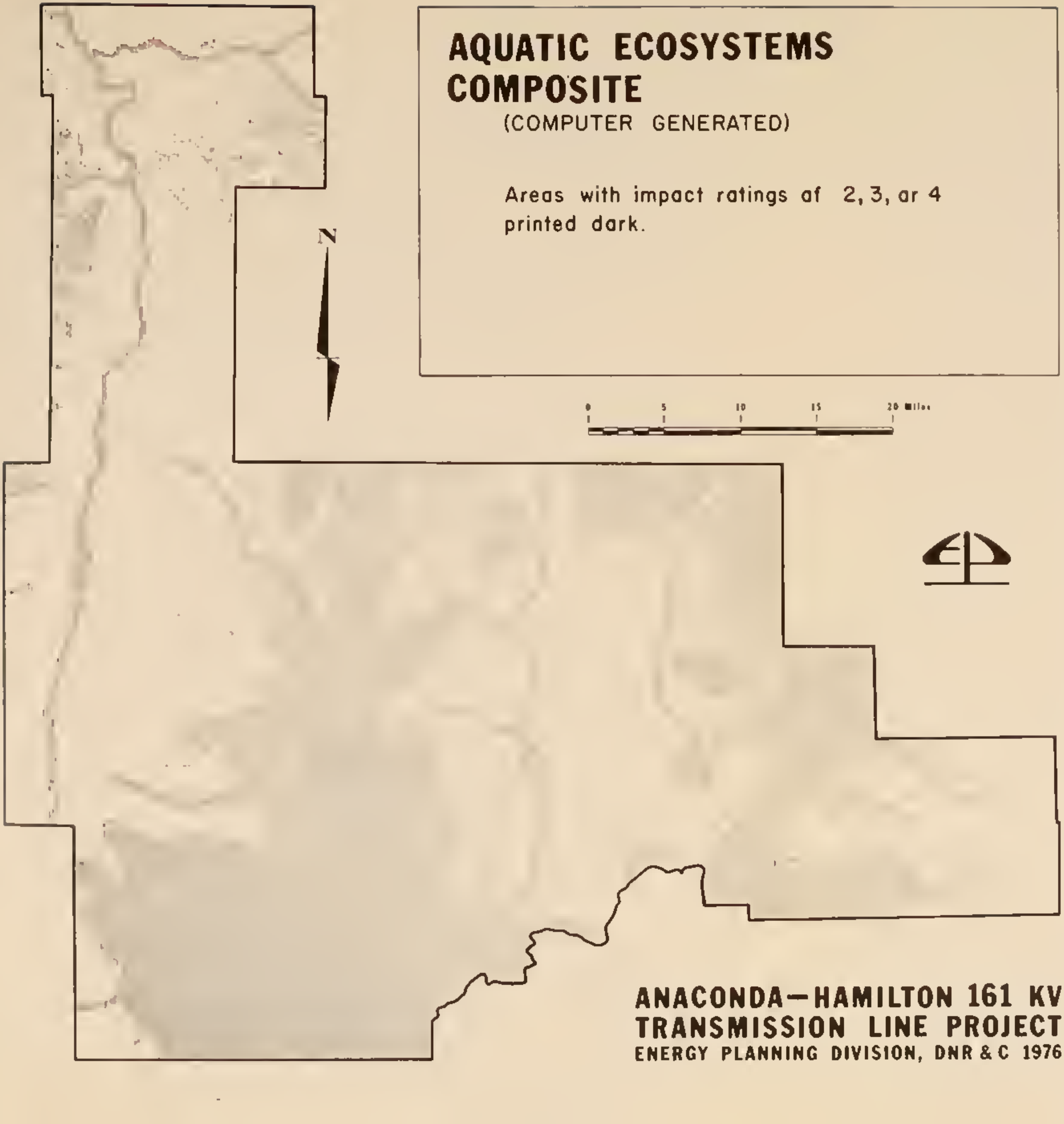
AQUATIC ECOSYSTEMS COMPOSITE

(COMPUTER GENERATED)

Areas with impact ratings of 2, 3, or 4 printed dark.



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AQUATIC ECOSYSTEMS COMPOSITE

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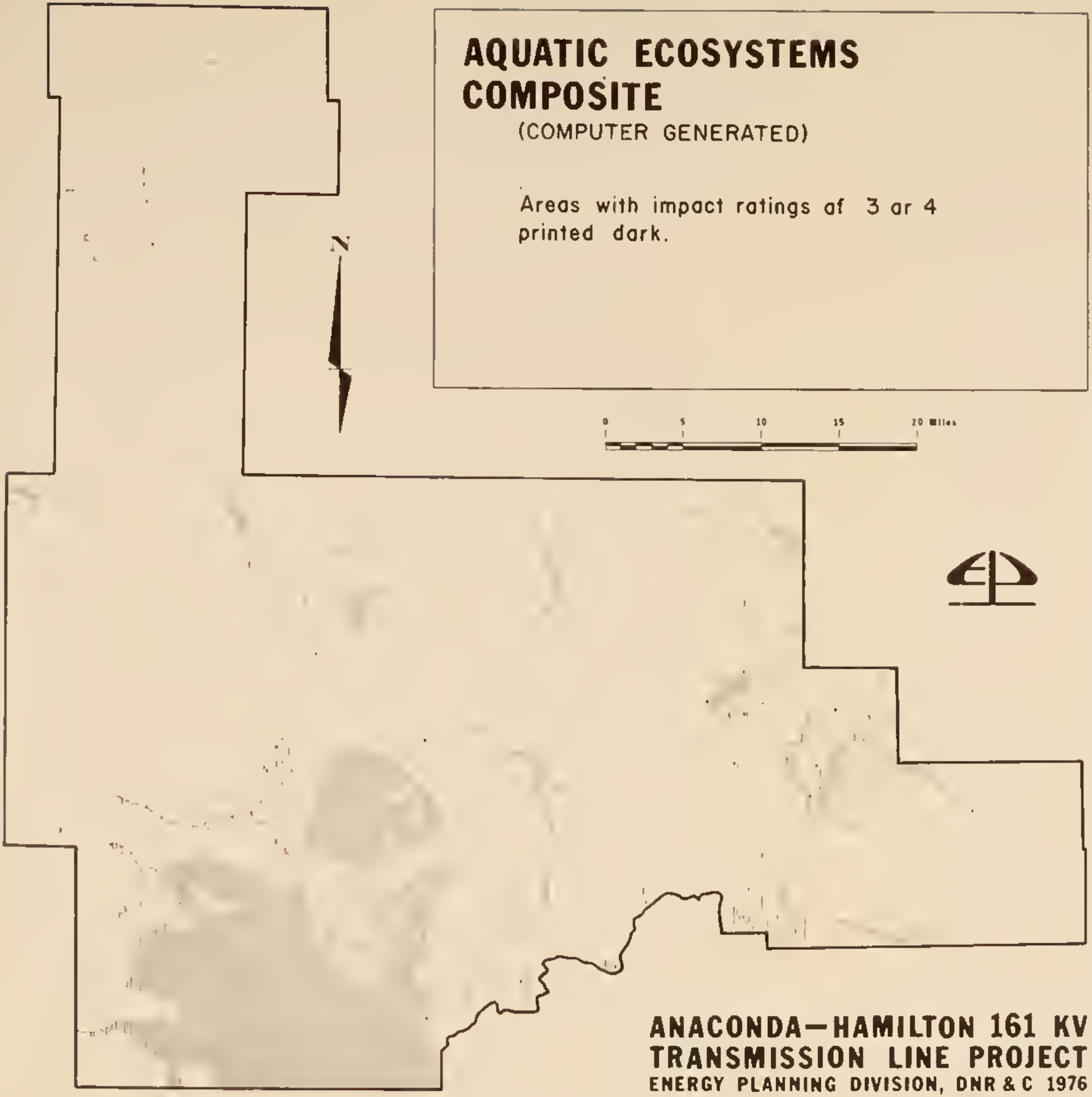

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units, and not in total biomass. For example, range land has been rated according to the number of acres necessary to support a cow, and forest land has been grouped by its ability to provide wood. Potential rather than extant productivity was chosen for assessment because current productivity reflects many variables which are subject to rapid change. Potential productivity seems to offer better guidance to power transmission line routing, since power lines require long-term dedication of land.

6.3.2. Land Classification

In this study, land has been classified according to the dominant use of the products taken from the land (food or fiber), and by the source of productivity (natural or man-enhanced).

6.3.2.1. Cultivated Land

Cultivated land is managed to provide food for humans and livestock. The crops are often introduced species that are nutured through environmental modification. The high productivity of these areas is now the result not only of the inherent capacity of the land, but also of energy supplements in the form of fertilizer, fuel, irrigation water, and selective biocides.

6.3.2.2. Range Land

Range land, like cultivated land, produces food for livestock, but it differs in that solar radiation is the sole source of energy. Primarily indigenous vegetation is found here, and productivity is determined mainly by soil, precipitation, and grazing.

6.3.2.3. Forest Land

While forests provide both wood and forage, wood productivity has been used for evaluation of forest land only because it is greater and more likely to be adversely affected by a transmission line.

The environmental factors that account for differential productivity in forests are variable and complex. Plant associations,[1] which are directly related to the biological potential of an area, are best suited to assessing the potentialities of sites (Daubenmire 1968) and have been used in forest productivity assessment.

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[1] All climax stands in which the dominants of corresponding layers are essentially the same, to the extent that any differences in composition are due to chance dissemination or to a transitory historic factors rather than to a fundamental dissimilarity in habitat potentialities, comprise one association (18).

6.3.3. Role of Productivity in the Economy

Governor Judge has emphasized the importance of agriculture to the Montana economy:

> "The material and human inputs necessary for producing, processing, transporting and marketing our many agricultural products directly or indirectly involves nearly every sector of our state's economy. Additionally, the growing importance of international trade has caused other countries to become vitally concerned with the patterns of our agricultural production" (USDA 1974).

Although yields have generally risen due to technological innovations and energy supplements, the area in farms has declined since 1964 (USDA 1974). Lands removed from agricultural production for structural use erode a productive base that cannot be easily replaced. This loss poses a significant problem in the study area (USDA 1973).

6.3.3.1. Cultivated and Range Land

Cultivated and range land are intimately linked because both types of land produce feed for livestock. Livestock production is the largest factor in the agricultural economy of the study area. In addition to producing livestock feed, cultivated land in the study area produces (in order of decreasing acreage): barley, winter wheat, oats, spring wheat, corn, sugar beets, and potatoes (USDA 1973).

In 1972, the four counties in the study area[2] contained 172,320 tillable acres valued at $4,805,121. Range land accounted for 930,411 acres assessed at $4,095,467. This land base supported 84,141 cattle and 12,844 sheep worth $7,351,860 (Montana State Board of Equalization 1972).

In 1973, the yearly average for agricultural employment was 1,740 workers, or 4.6% of those employed (Montana Employment Security Division 1974). In 1973, the total value of irrigated crop production in the four-county area was $25,225,900, and non-irrigated crop production was $2,961,100 (USDA 1974).

6.3.3.2. Forested Land

Reliable economic statistics on the highly variable wood products industry are not available for the study area, but the forests of the Bitterroot Valley support two major mills, two board mills, five post and pole mills, and three log building firms in the study area. In addition, approximately 15% of the study area's timber goes to Missoula for processing (USDA 1976). The logging industry probably employs more people than the mills, but statistics on the logging industry are unavailable.

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[2] Figures are for Deerlodge, Granite, Missoula, and Ravalli Counties.

East of the Skalkaho Divide, one mill is currently operating in Philipsburg and another is presently closed. There is a small mill west of Anaconda and small mills in Hall and Drummond that use timber harvested in the study area. One post and pole processor is located near Maxville.

Continued timber productivity is not only of local importance, but also national significance. The USFS holds in trust over 50% of the study area. National forests are managed in the best interest of the nation as defined by congress. Three legislative mandates, which guide USFS policy, are concerned with productivity. The Organic Act of 1897 specifies that national forests are established to protect the forests, secure a favorable condition of water flow, and furnish a continuous supply of timber. The Multiple Use-Sustained Yield Act of 1960, without rescinding the Organic Act, states that "National forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes," and that management of the national forests must assure ". . . high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land." More recently, the Forest and Rangeland Renewable Resource Planning Act of 1974 recognized ". . . the vital importance of America's renewable resources of forest and range." Among other things, it requires a supply-demand analysis and an inventory of renewable resources, including opportunities for increasing yield, and a determination of the present and potential productivity of the land. The Act requires the Secretary of Agriculture to develop a long-range program for the nation's renewable resources that will assure an adequate supply of forest and range resources in the future while maintaining the integrity and quality of the environment (USDA 1975). The Forest Service is financially compensated when power transmission lines cross national forest land. The fee is based upon 5% of the value of the line. For example, the MPC pays an average of $28.75/mile of line/year for ten miles of 161 kV line on national forest land near the study area. Assuming the right-of-way does not exceed the specified 80-foot-width, the average yearly payment would be $2.96/acre/year.

6.3.4. Nature and Magnitude of Potential Impacts; Mitigating Measures

6.3.4.1. Cultivated Land

I. Short-Term Impacts

Significant short-term crop reduction can occur on cultivated land, especially if construction takes place during the growing season. At worst, the right-of-way and access areas will be lost to crop production for an entire season. Construction-caused losses can result also from interference with sprinkler irrigation.

II. Long-Term Impacts

Unguyed line-supporting structures will take little land out of production. However, they can restrict mechanical treatments of cropland, sprinkler irrigation, and aerial dissemination of chemicals, increasing production costs lowering productivity. Line maintenance may entail occasional crop damage. As in forest and range land, air pollutants and electrostatic and magnetic fields from the proposed 161 kV line are not expected to be harmful to plants (DNRC 1976).

III. Mitigating Measures

Loss of productivity can best be minimized by consulting with the land owner to determine optimal line placement and time of construction. By constructing the line after crop harvest and before planting (or germination) of the following crop, and by constructing the line at the periphery of cultivated areas or on existing right-of-ways, productivity loss will be minimal. Temporary roads can be returned to productivity.

6.3.4.2. Range Land

I. Short-Term Impacts

The greatest impact on forage productivity is expected to come from road construction if earthmoving is involved. Usually earthmoving removes vegetation and provides a less hospitable site for future plant growth. The total road area, including cut and fill banks, constitutes a short-term productivity loss. For an example of the area involved, a 20-foot-wide roadway will occupy 2.4 acres/road mile, which will be lost to productivity for at least a few years.

Construction activities can also disrupt range rotation systems, resulting in less than optimal use of the forage resource. Cross-country vehicular travel can result in short-term productivity reduction.

II. Long-Term Impacts

The long-term impacts on range land forage productivity depends upon whether access roads are left open and untreated, or are seeded, mulched, and given protection for a year or two. If roads are abandoned, the finer soil particles quickly erode away and nutrients leach rapidly, often below plant rooting depths, causing long-term site deterioration. Lack of vegetation intensifies microclimatic extremes[3] such as temperature, humidity wind, and evaporation (Whitman, n.d.) near the soil surface. In scarified areas, such as roads, harsh abiotic environmental factors rather than biotic factors largely determine species composition and coverage.[4] The plants that originally prosper under these conditions usually have poor forage value, and site restoration accompanied by more desirable forage species comes slowly. Site deterioration is accelerated and recovery retarded by vehicular use of the road bed. Roads that are not closed anf revegetated can be considered long-term productivity losses.

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[3] Microclimate refers to the prevailing weather conditions in the atmosphere within the plant canopy or immediately above the plant canopy (Whitman, n.d.). It is this area that is of most important to plant survival (Daubenmire 1974).

III. Mitigating Measures

As on cultivated land, the land owner will best know how to minimize productivity losses through line placement and time of construction. Long-term impact can be minimized by proper road construction (see section 6.2.4.3.), road closures, and revegetation of scarified areas.

Hydroseeding or drilling and seeding offers the best chance of successful revegetation. In hydroseeding, a slurry of water, seed, and mulching agent is discharged from the nozzle of a truck-mounted apparatus. Mulching with straw or wood chips provides insulation from microclimatic extremes, inhibits erosion, favors microorganism activity, and enhances the physical properties of the soil. Drilling procedures are reviewed in the Interagency Forage, Conservation, and Wildlife Handbook, available from the Soil Conservation Service.

Table 6-3 lists commercially available grass species suitable for seeding. A mixture of at least three of these species enhances the chance of successful revegetation with good forage species. Seeding with these species favors return to forage productivity and helps prevent site deterioration.

Fertilization is likely to speed recovery and increase productivity, although it should be accompanied by seeding or opportunistic species may benefit. However, moisture is more frequently a limiting factor on range land than nutrient deficiency. Fertilization of range land has not proven to be economically renumerative, and is a questionable allocation of a relatively scarce resource.

Seed and mulch cannot assure revegetation unless the treated areas are given protection and time to recover. On federally-owned land, grazing should be deferred for a minimum of three years (USDA 1973). Road closures, deferred grazing, and revegetation can minimize the long-term impact of the proposed line on range land productivity.

6.3.4.3. Forest Land

I. Impacts

The impacts on commercial productivity per linear mile of power transmission

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[4] For example, water, temperature, light, or atmospheric conditions tend to be limiting in themselves, while competitive relationships and herbivores are of less importance than they are later.

TABLE 6-3

Elev.	Generic Name	Common Name	Pounds Seed Per Acre[1]
<5000	*Agropyron inerme* var. *whitmar*	Beardless wheatgrass	7.2
	Agropyron smithii var. *rosana*	Western wheatgrass	9.4
	Festuca ovina var. *duriscula*	Sheep Fescue	4
	Stipa viridula	Green needlegrass	26.3
>5000	*Agropyron trachycaulum*	Slender wheatgrass	7.4
	Bromis marginatus	Mountain brome	12.0
	Dactylis glomerata	Orchardgrass	4.2
	Stipa viridula	Green needlegrass	26.3
	Phleum pratense	Timothy	3.4

NOTE: *Seeding rates should be doubled for broadcast seeding.* Seeding rates are from the Interagency Forage, Conservation, and Wildlife Handbook, 1973. Figures have been adjusted for average purity and germination.

[1] Divide by number of species seeded

line are highest in forested areas. Here long-term and short-term impacts merge because the right-of-way is essentially removed from commercial production.

The applicant's design specifications call for an 80-foot right-of-way, which would mean that the right-of-way will require 9.7 acres of land per mile of line. However, actual right-of-way width is expected to exceed 80 feet in some areas for the reasons presented below.

For line reliability, the preferred line construction technique is to fell those trees that could fall into the line, which has a minimum ground clearance of 29 feet. Mean maximum tree heights for habitat types in the study area are as high as 132 feet ± 32 feet (Pfister et al. 1974), which suggests that trees beyond 40 feet from the centerline could threaten the line. Roads, which may exceed the line in length, can be an additional loss to the productive base.

The area logged for a power transmission line is lost to commercial productivity because it must be harvested before becoming economically mature. It is possible that posts or Christmas trees could be harvested in the right-of-way.

Line construction activities that cause scarification can result in site deterioration, as in range land. However, erosion and nutrient loss may be greater on range land due to more rainfall and greater slope.

Clearing of forests results in logging slash. If not disposed of, slash becomes a fire hazard, the source of potential insect outbreak, and an impediment to travel. If burned, slash contributes to air pollution.

II. Mitigating Measures

Long-term loss of commercial wood productivity from power transmission lines is not highly mitigative. Thus, avoidance of highly productive sites is a prime mitigating measure.

Although largely lost to commercial production for the life of the transmission line, the right-of-way need not be abandoned to site deterioration. Mitigating measures that preserve site quality and meliorate visual impact are listed below; they are tempered by practical consideration of line maintainence, the economic advantages of mechanical treatment, and the need for slash disposal to reduce the hazards of fire and tree-damaging insect epidemics.

II.A. Clearing

Conifers comprise the only family that can threaten line safety in all but riparian areas, and line clearing should be restricted to conifers except where scarification is necessary for construction and fire lines. Confiers (excluding regeneration) within the right-of-way proper should be removed, and the commercial portions utilized. Removal of conifer regeneration would involve scarification and invite a new generation of conifers, gaining little and contributing to site deterioration. Some shrub and herb species, if little distrubed, will prosper in the absence of an overstory and tend to inhibit conifer reproduction while maintaining site integrity.

The applicant's general vegetation treatment in forests is to remove all trees within eight to ten feet (slope corrected) of the centerline. Beyond this area, those trees which threaten the line are also removed. Determination of whether a tree is "threatening" is based upon tree height and distance to the line, whether the tree leans toward the line, and the apparent health and vigor of the tree. As a result of cutting such trees, remaining trees tend to lean toward the line due to phototropism and wind damage. When these trees become hazardous to the line, they are cut. The MPC notes that increasing restrictions on right-of-way clearing often make it necessary to treat right-of-ways annually for a few consecutive years after construction of a line.

In making suggestions for minimizing initial right-of-way clearing, one assumes that subsequent maintenance will be frequent, that roads will be kept open, and the slash disposal will be no problem. Loss of site quality would be minimized by a thorough initial treatment, followed by revegetation of scarified areas and no further treatment of the area until line safety is again compromised. Such a treatment may include removal and use of trees beyond the 80-foot right-of-way that threatened the line, or may in 20 years threaten the line. Trees selected for cutting could be chosen according to present height, distance from centerline, and projected growth. Under optimum conditions, trees in the study area could grow from 40 feet to 70 feet in 50 years, depending on habitat (Pfister et al. 1974).

II.B. Slash Disposal

If economically attractive, slash could be chipped for pulp and particle board use. The public could be encouraged to collect firewood from logged areas, further reducing slash.

If enough slash remains to require burning, concentration of slash (e.g., dozen piling) is preferable to broadcast disposal because it minimizes exposure of mineral earth and damage to understory species. Burning areas can be chosen to minimize visual impact.

II.C. Access Roads

Open roads invite irresponsible vehicular use, resulting in damage to vegetation and site deterioration. Roads closed to public use, with the provision that they may be used for transmission line maintainence, would cause less damage.

Using existing road systems to the fullest extent possible would minimize impacts. Logged areas are preferable to unlogged areas for line location.

II.D. Subsequent Vegetation Treatment

Construction practices aimed at prolonging the period before vegetation disturbance is again required, will minimize loss to productive capacity, and is also economically advantageous. Subsequent treatment of vegetation should center on conifer removal, and avoid scarification and damage to herbs and shrubs. Promoting the harvesting of Christmas trees in the right-of-way may reduce the need for future clearing.

II.E. Scarified Areas

Hydroseeding scarified areas can be expected to slow site quality deterioration, inhibit conifer establishment, and increase forage value in forests. A mixture of seed and fertilizer can be hand-seeded (e.g., with a Cyclone seeder) on scarified areas where hydroseeding or drilling is not feasible.

6.3.4.4. Relative Magnitude of Impacts on Productivity in Cultivated, Range, and Forest Land

Assured loss of commercial productivity is greatest in forest land. The impacts to productivity in cultivated and range land can be great, but they can also be minimal. In an average case, it seems that a power transmission line will result in a greater productivity loss on cultivated land than range land, for the very practices that account for the high productivity of cultivated lands (irrigation and mechanical treatment) can be curtailed by the proposed line. Therefore, it is most logical and economical to route a two-mile corridor on range land.

6.3.5. Inventory Procedures and Productivity Evaluation

6.3.5.1. Cultivated Lands

Cultivated areas were delineated using 1:124,000 color infrared NASA research aircraft transparencies. Productivity of cultivated areas is high, but also variable, because productivity and choice of crop is based upon management decisions as well as inherent land capability. For this reason, cultivated land was not subclassified.

6.3.5.2. Range Land

Delineations of range land were made using panchromatic 1:65,000 aerial photographs. Much of the range land of the study area has been abusively grazed, and so productivity ratings were based upon Soil Conservation Service data (Ross unpublished) rather than habitat types, a system not suited to abusively grazed range land (Mueggler 1974). In the SCS system, range sites, which are aggregates of soil types (Aandahl, unpublished), are combined with precipitation classes in order to estimate productive capacity. In general, the object of this system is to delineate range land having the potential to produce about the same kind or amount of plant cover even though the existing cover might vary drastically from this potential (Aandahl, unpublished), usually because of grazing practices.

The SCS range sites of the Anaconda-Hamilton area are listed below with the productivity code number. These numbers go from one to three, with three being most productive. The animal units[5] per month (AUM's) of the sites in excellent condition is given, along with some climax plants and those plants that commonly increase with increased grazing (Ross, unpublished). A list of other plants presently exhibiting high coverages in the study area is on file at the Department's Energy Planning Division.

1. Silty Range Site; 10"-14" Precipitation Zone.

.4 AUM/acre

Dominants in the Climax Vegetation	Plants that Increase with Grazing Pressure
Bluebunch wheatgrass	Big sagebrush
Routh Fescue	Needleandthread
Needleandthread	Prairie junegrass
Western & thickspike wheatgrass	Western yarrow
Green needlegrass	Fringed sagewort
Basin wildrye	Hairy goldenaster
Threadleaf sedge	Pussytoes
Native Legumes	Other weedy forbs
Big Sagebrush	Rabbitbrush
Winterfat	Broom snakeweed
Idaho Fescue	Plains pricklypear

2. Silty Range Site; 15"-19" Precipitation Zone.

.6 AUM/acre

Dominants in the Climax Vegetation	Plants that Increase with Grazing Pressure
Rough fescue	Idaho fescue
Idaho fescue	Prairie junegrass
Bluebunch wheatgrass	Timber danthonia
Basin wildrye	Kentucky bluegrass
Spike fescue	Timothy
Parry danthonia	Shrubby cinquefoil
Slender wheatgrass	Lupine
Lupine	Cinquefoil forbs

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[5] An animal unit is defined as one cow, or 5 sheep, or .67 of a horse.

Sticky geranium	Threadleaf sedge
Arrowleaf balsamroot	Sandberg bluegrass
Prairiesmoke	Onespike danthonia
Big Sagebrush	Annuals
Tall lakrspur	Snowberry
Prairie junegrass	
Timber danthonia	
Big bluegrass	

2. Saline Lowland Range Site; 10"-14" Precipitation Zone.

.6 AUM/acre.

Dominants in the Climax Vegetation	Plants that Increase with Grazing Pressure
Basin wildrye	Inland saltgrass
Alkali sacaton	Greasewood
Nuttal alkaligrass	Scrathcgrass
Alkali Cordgrass	Foxtail barley
Slender wheatgrass	Squirreltail
Western wheatgrass	Arrowgrass
Inland saltgrass	Povertyweed
Greasewood	Kochia
Buffaloberry	Buffaloberry
	Ross spp.

3. Sub-irrigated and Wetland Range Sites.

1.5 AUM/acre.

Dominants in the Climax Vegetation	Plants that Increase with Grazing Pressure
Tall reedgrasses	Kentucky bluegrass
Tufted hairgrass	Redtop
American mannagrass	Low sedges
Tall sedges	Foxtail barley
Slender wheatgrass	Meadow barley
Bearded wheatgrass	Boltic rush
Basin wildrye	Rocky Mountain iris
Willows	Horsetail
Shrubby cinquefoil	Arrowgrass
Prairie cordgrass	Golden pea
Elephanthead	Cinquefoil forbs
Monkeyflower	Thistles
Native Clovers	Other weedy forbs
Paintbrush spp.	Annuals
Blue-eyedgrass	Shrubby cinquefoil

The three range land productivity categories described above, as well as cultivated land, are represented on the map entitled "Agriculture and Range Productivity" contained in the back pocket. Bunchgrass-dominated associations found in generally forested areas were rated in productivity category two. Sedge- and willow-dominated meadows found in otherwise forested areas were rated in category three.

6.3.5.3. Forest Land

The forest land of the study area was inventoried using the Forest Habitat Types of Montana classification (Pfister et al. 1974). A habitat type is a unit of land that is capable of supporting a certain plant association, for which the habitat type is named. Habitat types consider floristics, dominance, layered structure, soil factors, microclimate, and succession (Daubenmire 1968). Because habitat types are environments with equivalent biotic potential, they are good predictors of potential productivity.

In habitat typing, certain plants are recognized to be more useful indicators of specific environmental parameters than others,[6] and reproductive success if given special consideration. The associations for which habitat types are named are abbreviated as combinations of overstory/understory species (e.g., the Douglas fir/snowberry habitat type).

The Bitterroot, Deerlodge, and Lolo National Forests provided habitat type data for the portions of the study area within their boundaries. Forests on private lands were typed by Department personnel. In general, the procedures were the same.

First, ground truth was obtained by sampling, as thoroughly as possible, the area under consideration. Aerial photographs and/or contour maps were taken into the field and the sample areas located and recorded. The slope, slope aspect, slope position, horizontal configuration, and elevation were recorded. The coverage categories of all indicator plants (Pfister et al. 1974) were recorded, and the habitat type key was used to tentatively identify the type being sampled. The description of the habitat type identified was then compared with the sample area to determine if typing was correct.

Typing was repeated on permutations of slope, aspect, elevation, etc., eventually allowing mapping of areas not sampled based upon data obtained from aerial photographs and contour maps. The "Generalized Distribution of Habitat Types" (Pfister et al. 1974) for the area was also useful when mapping habitat where field identification could not be performed. On 119 areas sampled and typed by the Department, species coverage data for all plants were recorded for wildlife assessment of habitat types.

The goal of this inventory was to map the forests of the study area by potential productivity category, allowing identification of routes minimizing loss of productive land and comparative evaluation of the impacts of alternative routes. To do this, the forest habitat types of the study area were grouped in productivity categories using the median values of yield capability ranges (Pfister et al. 1974). The productivity categories and their component habitat types follow. These categories are represented on the map entitled "Forest Productivity" contained in the back pocket.

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[6] Such plants, called "indicator plants," are those whose ecological amplitude is fairly narrow, and fairly well understood.

1. Under 50 cu. ft./acre yr. Habitat types: limber pine/bunchgrass, limber pine/common juniper, ponderosa pine/bunchgrass, ponderosa pine/bitterbrush, ponderosa pine/snowberry, Douglas fir/bunchgrass, Doublas fir/kinnikinnic, subalpine fir (Whitebark pine)/grouse whortleberry, subalpine fir/wood rush, whitebark pine-subalpine fir, subalpine larch-subalpine fir, scree. Logged areas and forested rock were also mapped in category one.

2. 50-80 cu. ft./acre yr. Habitat types: Douglas fir/ninebark, Douglas fir/beargrass, Douglas fir/blue huckleberry, Douglas fir/twinflower, Douglas fir/snowberry, Douglas fir/pinegrass, Douglas fir/white spirea, subalpine fir/beargrass, subalpine fir/blue huckleberry, subalpine fir/grouse whortleberry, subalpine fir/pinegrass. Aspen stands were rated in this category because Douglas fir appeared to be the indicated climax tree species in most aspen stands.

3. 80-110 cu. ft./acre yr. Habitat types: Douglas fir/dwarf huckleberry, spruce/sweetscented bedstraw, spruce/twinflower, subalpine fir/sweetscented bedstraw, subalpine fir/dwarf huckleberry, subalpine fir/bluejoint reedgrass, subalpine fir/twinflower, subalpine fir/fool's huckleberry.

4. Over 110 cu. ft./acre yr. Habitat types: grand fir/beargrass, ground fir/queen cup beadily, subalpine fir/queen cup beadily. Cottonwood riparian communities were included in this category (Pfister and Arno, personal communication). See Appendix D for a discussion of bottomland hardwood communities.

Forest habitat types produce forage as well as wood, and forage values can be assigned to habitat types (DNRC 1976). However, the effect of the proposed power transmission line on forest forage productivity is not quantitatively predictable. After initial clearing, scarified areas would exhibit reduced forage productivity, while areas from which the forest canopy was removed and the understory vegetation left intact would likely display increased forage productivity. As a forest canopy returned, forage productivity may approach pre-line levels. It is not clear whether the net result is beneficial or detrimental.

6.3.5.4. Altered Area

Productivity categories have not been mapped in an area around Anaconda (see productivity maps in the back pocket). Because of heavy metal and sulfur dioxide contamination, this area does not have an equivalent in the rest of the study area, and, hence, neither range sites nor habitat types are applicable. Only a longitudinal study could determine productive capacity. The effects of heavy metals and sulfur dioxide on land and vegetation is complex, and is briefly explained in Appendix D of this publication.

6.4. Visual Concerns

6.4.1. Introduction

Over the past decade or so, transmission lines have become more controversial. As the size and number of lines increase, society is changing its mental perception of such facilities. Transmission and distribution lines are no longer viewed as status symbols or symbols of "progress" as they were in the earlier years of electrical use. Greater concern for protecting the visual character of the landscape is at the root of much of this new-found controversy. In essence, electrical transmission lines are often viewed as "ugly" or "out-of-place" with the existing visual character of the landscape, whether the landscape is urban, suburban or rural. This emotional reaction brought on by the sight of a transmission line is its visual impact.

Visual impact can be of several types and of varying intensity. A transmission line may not produce the same kind or degree of impact on two different persons or even on one person at two different times. Therefore, visual impact assessment is not an exact function and is subject to differences in approach and interpretation. Visual impact, though its evaluation may be subjective, is in fact a major concern.

6.4.2. Methods

The visual impact assessment in this study uses two models to arrive at a map of the study area which rates areas in terms of visual suitability of a transmission line entitled "Visual Analysis-Potential Impact," found in the back pocket of this publication. The first of these modesl, the visual character model, is defined as a reflection of the degree to which the activities of man dominate the landscape. A map was produced containing five categories on the basis of human alteration as follows:

1. Maximum alteration of the landscape, such as urban and industrial areas
2. Altered landscape with a dominance of man-made features, such as cultivated agriculture
3. Altered landscape with natural features in dominance, such as rangeland
4. Little if any human alteration, such as roadless areas
5. Mixed alteration where small areas of the first four levels occur in close association

The degree of alteration is only one aspect of the visual character of a scene. For example, in an area of maximum alteration, a large transmission line would be less "out-of-place" around a smelter or oil refinery than in an area of one-story homes and inconspicuous commercial buildings. This kind of difference is taken into account in the analysis.

Transmission lines are inherently no better or no worse in visual character than other activities of man. A person has a sense of aesthetic appreciation, developed over a lifetime, which is a result of that person's experiences, education, values, and perception of the world about him. To most persons, however, certain kinds of landscapes accept a transmission line with less visual impact than others. Through years of experience most people have been conditioned to accept utility poles along highways and railroad tracks. The visual impact of the same poles and wires crossing a city park or a nicely landscaped cemetery would, however, be considered objectionable by most.

Another emotion that is part of the visual impact is what one expects to see in a variety of circumstances. One's visual expectation of an area or scene is also determined by that person's experiences, education, values, and purpose for being there. Expectations are built over time through literary sources, advertising, and previous associations with similar landscapes. For example, a person passing through the entrance of a national park often alerts himself to the fact that he is now in the park and to look for bears, geysers, or whatever he has come to expect of that park. Similarly, a person passing from an urban area into a less developed region, via some lonely road or trail, begins to expect to see or not see certain things. Each person has a mental image of places such as city parks, fishing access sites, garbage dumps, steel mills, and slum neighborhoods. Visual impact, either positive or negative, is produced when a person sees what he does not expect. If one imagines a mountain wilderness area, he may picture in his mind snow-covered peaks, clear lakes, and tall green trees. Similarily the New England countryside brings to mind small farms, stone fences, and small villages of old houses and a white church. If one visits either place and sees a conspicuous transmission line, he sees something outside of his expectations of the place. On the other hand, places like "down by the tracks" or "the industrial side of town" conjure up other expectations which do not preclude seeing a transmission line.

Examples given above, to emphasize the expectation concept, are rather simplified. Places within the study area have various expectations placed upon them by persons who are familiar with them now or may come to know them at some future time. A second map was created containing five categories based on expectations of a transmission line. These five categories are:

1. High: Areas where a transmission line would have high impact on expectations such as wilderness-like areas, scenic rivers and historical sites (Custer didn't fight the Battle of the Little Bighorn under a transmission line).

2. Moderately High: These areas include blue ribbon trout streams and forests.

3. Moderately Low: The expectation not to see a transmission line decreases as man's influence becomes more evident, e.g., near small communities and along linear elements such as railroads, highways, and other utility lines. How much a transmission line looks "out-of-place" in these areas is largely a function of the size and design of the towers and their placement.

4. Low: Urban and industrial areas represent a low expectation not to see transmission lines. However, poor centerline placement of the line can nevertheless create visual impacts.

5. Undifferentiated: Certain landscapes are diverse, containing a number of land uses in close proximity. Centerline selection is of greater importance in this category.

The visual analysis map appearing in the back pocket is the result of overlaying the two maps described above. In establishing the value to be used for a given point in the study area, the greater (impact) value of the visual character and expectation models for that point is selected. The five categories on the visual analysis map are discussed in greater detail here.

I. Very High Potential Impacts

Non-selected roadless and USFS new study areas are undeveloped and roadless; explicit contrast would result if a transmission line were placed in such a location. The Sapphire Mountain Range contains most of the non-selected roadless area, and one USFS new study area is found in the Flint Creek Range. High expectation impact areas are represented by campgrounds (historical sites are included with their surrounding areas because most of the sites are scattered or in urban areas within this study area). Three areas have concentrations of campgrounds: Georgetown Lake, Rock Creek Drainage, and the Bitterroot Valley.

II. High Potential Impact

There is moderately-high expectation not to see a transmission line in forest areas and blue ribbon streams (fishing streams of national or state importance). In this study, closed canopy forest boundaries (heavy tree cover) are used. The aesthetic impact of a transmission line through open forest is less than it would be in a closed canopy; the impact in a closed canopy would be high.

III. Moderate Potential Impact

This area includes: (1) agricultural lands; e.g., in the Bitterroot Valley and Philipsburg Valley, and (2) concentrated developed recreational lands; e.g., the Georgetown Lake area.

IV. Small Potential Impact

These areas are characterized by human presence and associated features and are dominant in the Bitterroot Valley (Missoula to Hamilton), the Philipsburg Valley, and the area from Georgetown Lake to Anaconda.

Undifferentiated lands include most of the open range land in the study area, and they have a small potential impact on the expectation model.

V. Slight Potential Impact

The mixed levels of alteration from the visual character model are included in this impact category. The mixed levels include houses and commercial and industrial buildings with no specific dominance of any use. These areas are adjacent to the urban areas of Missoula, Hamilton, Anaconda, and the smaller communities of Philipsburg and Stevensville. The character of these areas is generally compatible visually with transmission lines of the 161 kV size (wooden poles).

Low expectation not to see a transmission line is typical of urban areas, small communities, and industrial areas. Transmission lines are a product of this type of land use, and as such, is a normal occurrence. These areas include Missoula, Hamilton, and Anaconda.

6.5. Effects on Land Use Patterns

6.5.1. Introduction

Land use is a physical delineation of man's culture and his relationship to the land. It is defined by both physical and cultural characteristics of an area. For example, physical properties of land, such as topography, soil, and water availability affect to a certain extent the manner in which that land is used. Equally important to an understanding of land use patterns are cultural factors, such as social beliefs, legal restraints on the use of certain types of land, and ethnic habits.

Construction, maintenance, and physical presence of a 161 kV transmission line will have physical impacts on the land, and social impacts on attitudes. The impacts of routing a transmission line through specific types of land use will vary in degree because of concern from differing sources. One persisting problem is that land owners and special interest groups often do not share the same viewpoints regarding land use. Persons having special interests within the study area are local land owners and residents, governmental units having jurisdiction within the study area, local interest groups, regional entities or interest groups, and national entities or interest groups.

Decisions regarding land use must sometimes be based upon intangible factors (see section 6.7., "Socio-Economic Concerns"). Nevertheless, determinations must be made regarding the importance of present land uses in relation to total land use needs of an area, both present and future.

6.5.2. Land Use Components

Land use consists of five components in the study area: (1) settlement areas, (2) agricultural lands, (3) recreation areas, (4) specially managed areas, and (5) historical/archaeological sites. All areas are mapped, the maps serving as geographical inventories and graphic representations of land use patterns in the study area. A brief definition of each component follows. Their specific relationship to the study area is discussed in section 6.5.4., "Inventory Analysis."

6.5.2.1. Settlement Areas

Settlements include urban areas, small communities, scattered built-up areas, and subdivisions.

By definition, urban areas have populations of 2,500 or more, and small communities have between 100 and 2,500 people. Scattered, built-up areas consist of congregations which contain more than ten houses per square mile and are not defined as small communities. Subdivisions generally have the same definition as scattered built-up areas, but have recorded boundaries.

6.5.2.2. Agricultural Lands

Agricultural land consists of irrigated and dry cropland, bottom land mix, and grazing land.

Irrigated cropland is acreage upon which water is applied by an adopted method on a recurring basis as an integral part of crop production. Dry cropland is acreage which receives no supplemental water on a recurring basis. Bottom land mix contains small acreages of irrigated and/or dry cropland mixed with grazing land (no dominant use). Grazing land includes three subtypes: pasture land, range land, and grazed forest land.

6.5.2.3. Recreation Areas

Recreational land use is subcategorized into areas of site-specific and dispersed activities. Site-specific recreation refers to activities represented by exact locations, such as parks, campgrounds, and developed ski areas. Dispersed recreation includes activities that are not restricted to fixed locations, such as cross-country skiing, fishing, backpacking, and hiking. Recreation areas, historical and archaeological sites, and specially-managed areas are depicted on the map entitled "Recreation."

6.5.2.4. Specially-Managed Areas

Specially-managed areas are regions which possess natural wilderness characteristics, and are administered to maintain their wilderness qualities. In order to ensure the preservation of wilderness-like lands, legal constraints have been placed upon them by various governmental agencies and legislation.

The Anaconda-Hamilton study area includes five categories of specially-managed areas. They are listed below in order of increasing number of possible legal restrictions upon land use.

1. Wilderness study areas proposed by the USFS. New wilderness study areas are national forests lands which have been selected by the USFS for possible recommendation to Congress as additions to the National Wilderness Preservation System. The Anaconda-Hamilton study area contains one such area of 3,680 acres in the Flint Creek Mountains; it is shown on the Recreation map.

2. Roadless areas designated by the USFS. Wilderness-like areas not classified as new study areas are designated as non-selected roadless areas by the USFS.

3. State of Montana game management areas. Game management land is owned or leased by the Montana Fish and Game Commission (MFGC), and managed to protect critical game habitat (primarily elk winter range).

4. Wildlife refuges. Refuges are managed and protected from detrimental land use activities by the U.S. Bureau of Sport Fisheries and Wildlife. These areas contain unusually productive or critical wildlife habitat (primarily waterfowl breeding and wintering areas).

5. Wilderness areas proposed by citizens. This category is given authority by U.S. Senate Bill 393, providing for the study of certain lands to determine their suitability for designation as wilderness in accordance with the Wilderness Act of 1964. Citizen-proposed wilderness areas are shown on the Recreation map.

6.5.2.5. Historical and Archaeological Sites

The National Register of Historic Sites was created in response to the National Historic Preservation Act of 1966, an ". . . act to establish a program for the preservation of national historic properties throughout the nation and for other purposes" (Federal Register). Sites which have played significant roles in regional, state, and local history or contain material remains of past life are listed in the Montana Historic Sites Compendium (1975).

6.5.3. Inventory Process

The study area inventory is depicted in two maps: (1) Existing Land Use--Site Patterns (contained in the back pocket), and (2) Recreation. The Land Use map shows settlement areas and agricultural areas. The Recreation map delineates recreational and specially-managed areas, and historical/

archaeological sites. Agricultural categories were mapped directly from color infrared transparencies. Mapping information for the remaining categories was obtained from government agencies (county, state, and federal), local city and county planners, or appropriate literature (see map legends and literature citations for sources).

6.5.4. Inventory Analysis

The Anaconda-Hamilton study area is topographically diverse, forming several homogeneous land use pattern areas (see Land Use map). Five are distinguishable: (1) the Bitterroot Valley, (2) Philipsburg Valley, (3) Anaconda area, (4) Georgetown Lake recreation and historical mining area, and (5) the intermediate area, which includes the Rock Creek drainage (see Figure 6-1). A reconnaissance of each area follows and an integrated overview of the total study area is summarized at the end of this section.

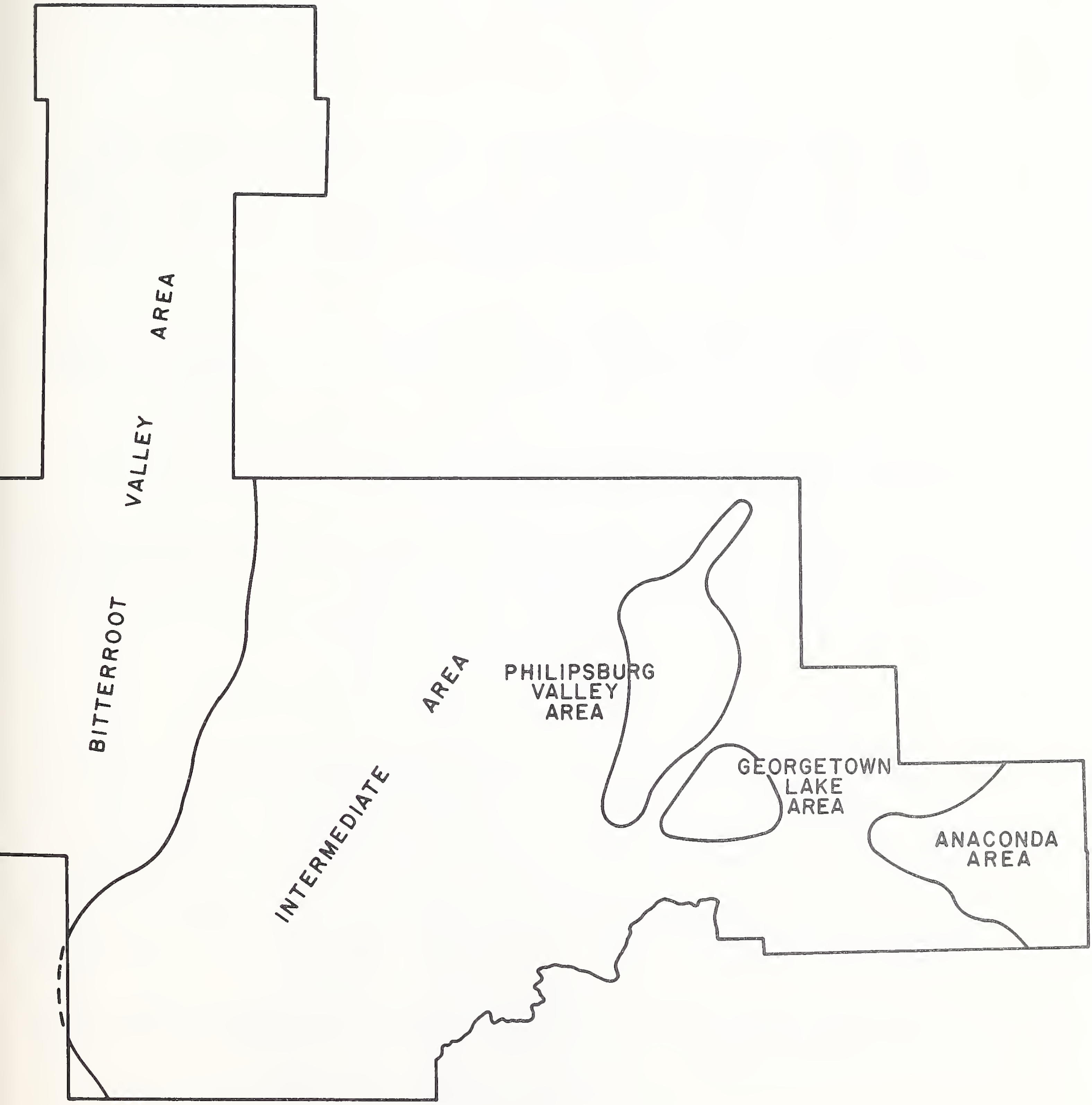
6.5.4.1. Bitterroot Valley

The Bitterroot Valley is bordered on the north by Missoula (1970 population; 29,497) and by Hamilton (1970 population; 2,499) on the south. Several smaller communities are located on the Valley floor: Lolo (1970 population; 1,500), Florence (1970 population; 45), Victor (1970 population; 300), Corvallis (1970 population; 400), Woodside (1970 population; 35), and Stevensville (1970 population; 829). The Valley is bisected by the Bitterroot River north to south and bordered by mountain ranges on the east and west.

Generally, sequential arrangement of agricultural land from the Bitterroot bottom lands to the flanking mountain ranges is as follows: (1) bottom land mix, (2) irrigated lands, (3) dry cropland, (4) rangeland, and (5) forest lands. Irrigated lands make up the largest cropped acreages, benefiting from water available from the Bitterroot River and its tributaries.

Subdevelopment has intensified in the last ten years on the Valley floor (Environmental Information Center 1974). Rural non-farm populations have increased, while rural farm populations have decreased (U.S. Census), indicating that subdivision activity is changing land use and population patterns.

Recreational activities are prevalent in the Bitterroot Valley and flanking mountain ranges. Numerous campgrounds, fishing access sites and semi-developed recreational areas exist along the Bitterroot River and surrounding forested mountains (see Recreation map). Missoula and Hamilton are centers for developed recreation, such as golf courses, tennis courts, ans swimming pools. A variety of dispersed recreational activities, such as cross-country skiing, backpacking, hiking, hunting, and fishing, occur on private and public lands in the Valley area.



GEOGRAPHICAL HOMOGENEOUS AREAS

Figure 6-1

The Bitterroot Valley has an interesting historical past which is represented in several national and state historical landmarks. Some of these landmarks are Lolo Pass, St. Mary's Mission Church, and Fort Owen near Stevensville. Several others are shown on the Recreation map.

6.5.4.2. Philipsburg Valley

The Philipsburg Valley area (see Figure 6-1) is centered around the community of Philipsburg (1970 population; 1,128). The Valley is encircled by mountains and intermediate foothills, and drained by Flint Creek, flowing north through the Valley. The Flint Creek Range flanks the Valley on the east side and John Long Range is on the west. Except for Philipsburg and Maxville (1970 population; 50), the Valley is completely rural agricultural.

Agricultural categories in the Valley include: (1) bottom land mix, (2) irrigated land, (3) dry cropland, and (4) range land (see Land Use map). Sprinkler irrigation has grown steadily with 30 new systems added since 1970 and at least 6 more planned for 1976 (SCS).[7]

Forestry and mining have historically been two important land uses in the Philipsburg area. Sawmills are presently strong in the local economy, but mining has been at a low point for the last few years.

Most of the historical sites in the Philipsburg area are connected with early day mining and milling activities. One such area, the Granite historical area, is listed in the Montana Historical Compendium. It is located approximately three miles east of Philipsburg (see Recreation map).

6.5.4.3. Georgetown Lake Area

The Georgetown Lake area (see Figure 6-1) is located between the Flint Creek Mountain Range on the north, and the Anaconda Pintler Range on the south. Georgetown Lake is about 6,424 feet above sea-level. There is a gentle sloping area surrounding the lake, which grades into steeper and rockier land. Georgetown Lake has a surface area of 2,768 acres and nearly 19 miles of shore line. Echo and Silver Lakes are part of the area and are somewhat smaller than Georgetown Lake. The area had approximately 300+ residents in 1973 and active sub-divisions were attracting even more residents (Georgetown Lake Pre-Study 1973).

The Georgetown Lake area is given special attention in this study because of its recreational activities and its historical mining contributions to the region and state.

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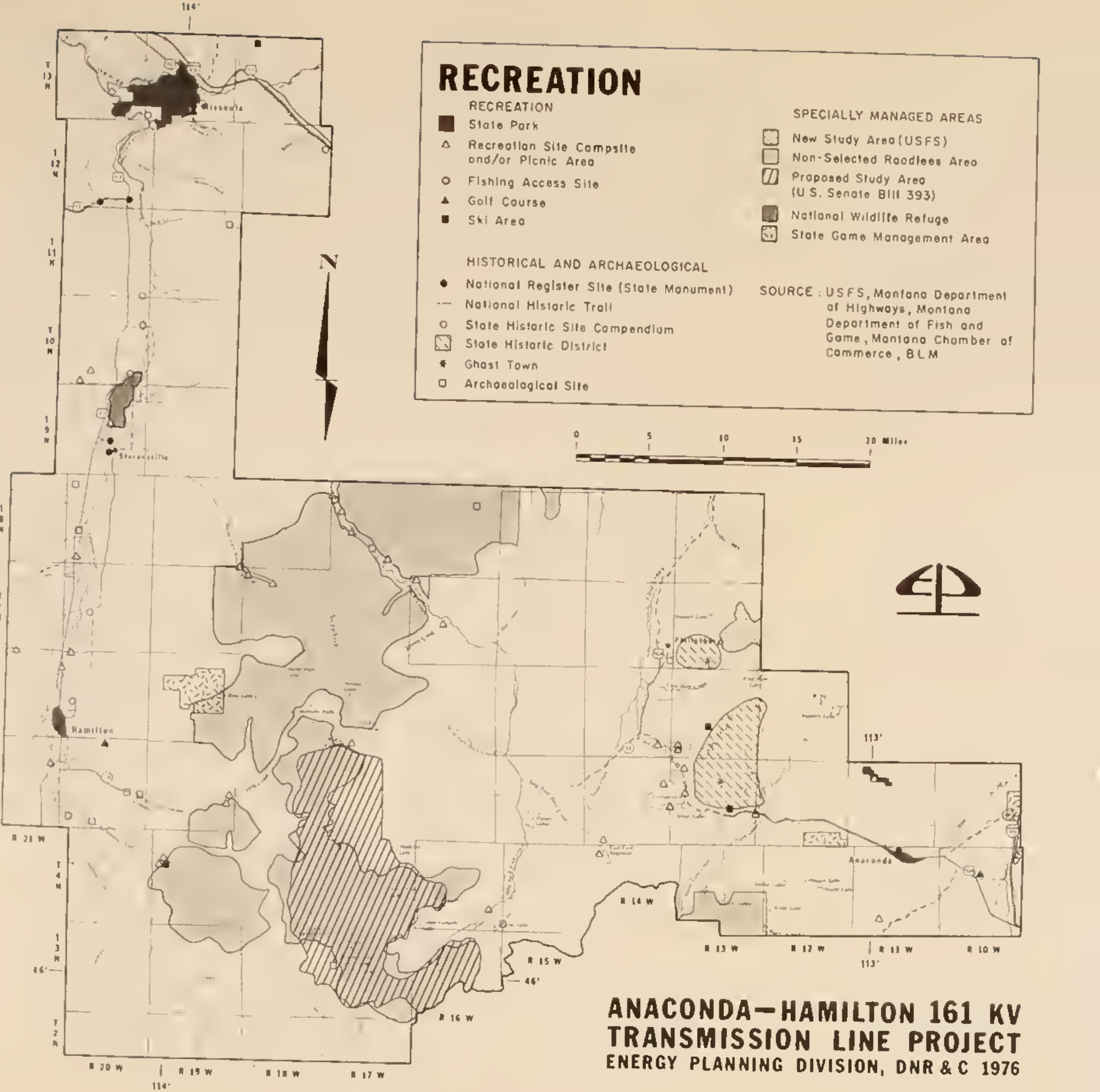
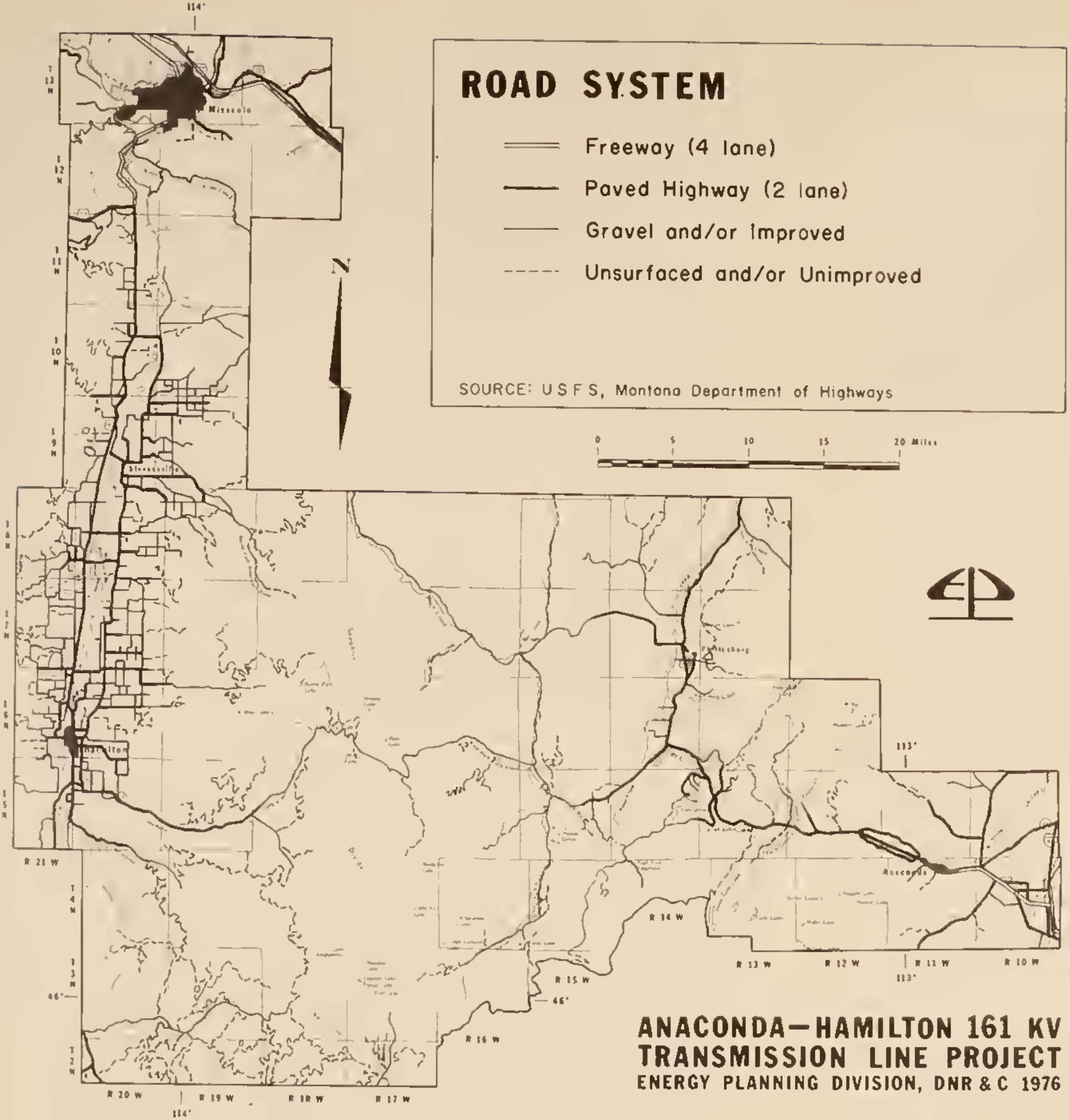
[7] Information obtained from Soil Conservation Service office at Philipsburg. There are systems that only the SCS assisted in planning.



ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976



ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976

The area provides several types of intensive recreation, including fishing, camping, picnicking, boating, snowmobiling, and skiing. Two ski areas, Discovery Basin and Wraith Hill, support mountain recreational activities in winter months, including snowmobiling. The Georgetown Lake area has provided an ideal location for such recreational activities for some time. According to the Georgetown Lake Pre-Study (1973), "Georgetown Lake is the most heavily fished lake in the state. The climate, scenery and clean air have attracted people to the area for the past 80 years." (Georgetown Lake Pre-Study 1973).

Mining was an important part of the area's development. The Cable, Gold Coin, and Southern Cross Mines were all discovered in the immediate vicinity between 1862 and 1868. The mining area (see Recreation map) is now a designated historical area in the Montana Historical Sites Compendium.

6.5.4.4. Anaconda Area

The Anaconda Area (see Figure 6-1) is predominantly urban industry. The area is situated on the east side of Deer Lodge Valley and extends up into Warm Springs Creek drainage. There are four separate communities or sub-areas within the Anaconda area. Anaconda is the largest community, with a 1970 population of 9,771. The other three areas are: (1) West Valley (1970 population, 2,626) immediately west and adjacent to Anaconda city limits, (2) Opportunity, about four miles east of Anaconda (1970 population, 930; survey Northwest Planners), and (3) Warm Springs (1970 population, 500). Anaconda is classified as an urban area (U.S. Census) and the other three communities are considered small residential communities.

The Anaconda Company's smelter operation is the main employer in the area and controls approximately 7,630 acres for industrial purposes (Northwest Planners 1973). Agricultural lands occur on the east side of the Anaconda Area (see Land Use map), and irrigated land is present in the West Valley community area. There are several historical sites located in Anaconda proper, but are not in proximity to the location of the proposed transmission line.

6.5.4.5. Intermediate Area

The intermediate area (see Figure 6-1) is the remaining land between the other four designated areas. Except for parts of the upper Rock Creek drainage, this area is generally composed of mountains, foothills, forest, and range land. Parts of four mountain ranges are included in this area: The Sapphire Range, Flint Creek Range, John Long Range, and Anaconda Range. The Rock Creek drainage area, from approximately five miles above the Middle and East Fork confluence down to the Willow Creek confluence, is generally used for agriculture within a mile on each side of the creek. Primary uses for the remaining lands in the intermediate area are recreation, forest management (logging), grazing, and mining. Large amounts of national forest lands cover over 70% of the area.

Opportunities for present and potential recreational use are numerous. Much of the area is roadless (see Recreation map) and contains many developed and undeveloped camping areas. Rock Creek is a trout stream of state and national importance below the confluence of West and Middle Fork. The area from Willow Creek down Rock Creek to the study area boundary is an intensive camping and fishing domain. Other frequently-used areas include: the Moose Lake vicinity in upper Middle Rock Creek (USFS, personal communication), East Fork (Rock Creek) reservoir area, and Skalkaho pass. Dispersed recreation, such as snowmobiling, cross-country skiing, backpacking, and walking is also extensive throughout the area.

The intermediate area contains the bulk of specially-managed lands within the total study area. These include several roadless areas, a USFS-proposed wilderness area, and an area represented in U.S. Senate Bill 393, the 1975 Montana Wilderness Bill.

6.5.5. General Impacts

General impacts, both direct and indirect, refer to effects of the proposed facility on the land use components of the study area. Impacts on specific geographical areas are discussed in section 6.5.6.

6.5.5.1. Direct Impacts

Direct impacts consist of all cultural and physical relationships that are affected by the existence of a transmission line itself. For example, transmission line interference with a sprinkler irrigation system is a direct impact. Each land use component which is directly-affected by transmission lines is discussed below. Consideration of short-term, long-term, and irreversible impacts is incorporated in the discussions.

I. Settlements

Impacts in residential areas affect people in terms of space. Man maintains a psychological protective space. When this space is subject to change by introduction of a new object, he is detrimentally affected. Possible impacts of transmission lines on settlements include interference with communication systems, audible noise, site-specific tower location interferences, and effects on aesthetic values.

II. Agriculture

The mobility of irrigation equipment may be impaired by placement of poles and guying wires. This may cause some land to be reverted to non-irrigated use, or be taken out of production altogether. The construction period would have a minimal physical impact on irrigated lands since they are tilled periodically; however, crop production would be reduced if construction occurred during planting, growing, or harvest seasons of a particular crop (Algard 1975). Maneuverability of farm equipment may be hindered; however, the problem may not be as great on irrigated acreages as on dry cropland, since equipment size is usually smaller.

Possible impacts of a transmission line upon dry croplands may occur as a result of the construction period, unauthorized use of access roads, and inability to maneuver farm equipment. The large size of equipment used on dry land tracts is so cumbersome that maneuvering around transmission line poles hinders efficiency (Algard 1975).

Grazing lands are vulnerable to unauthorized use of access roads, decreasing the likelihood of preserving a high-quality vegetative cover. In addition, disruption of range and pasture procedures established by the land owner or user may occur during the construction period.

III. Recreation

Since transmission lines do not interfere with the actual process of hunting, fishing, or hiking, impacts are related to the visual presence of the line (see section 6.4. "Visual Concerns") and land accessibility. Road construction may open more areas of public land for recreational use, thus benefiting the outdoorsman who uses these roads to get into an area. However, fear of such increased accessibility may result in the posting of formerly open land by private land owners, thus adversely affecting some people.

IV. Specially-Managed Areas

The wilderness characteristics of new USFS study areas, roadless areas, and game management areas are legally protected. Before a permanent installation (such as a transmission line) is allowed to cross such an area, a detailed land use study must be prepared and presented as a public environmental impact statement. Alternatives to classifying an area as wilderness must be considered in the statement. The amount of time required to prepare these studies precludes consideration of new study areas as possible routes for the proposed Anaconda-Hamilton line. If used for a corridor, these areas would be unsuitable for possible future wilderness designation.

V. Historical and Archaeological Sites

Historic sites are protected by the National Environmental Policy Act (NEPA) of 1969, which requires an environmental impact statement prior to alteration of such areas. Certainly, the addition of a transmission line could only diminish the attraction of a historic site. However, because historical and archaeological sites are small parcels of land, they can usually be avoided within a two-mile-wide corridor. Groups of sites may be more difficult to avoid (example: the George/Henderson, Colorado 115 kV line project in 1968).

VI. Functional Exclusion Sites

The functional use of airports prohibits construction of physical obstacles such as transmission lines.

6.5.5.2. Indirect Impacts

Indirect impacts are part of a chain reaction of events resulting from the initial direct impact. For example, a transmission tower necessitates the discontinuance of irrigation processes. Enforced reversion back to dry-land farming may then result in the indirect impact of loss of money.

I. Settlements

Expansion of urban areas introduces a gain-loss concept insofar as land use is concerned. For example, a gain in one type of service may cause a deterioration in other services. For example, a new factors may substantially increase the load on existing public facilities such as water, sewage, and streets (Summers 1976).

II. Agriculture

Access roads in agricultural areas may cause a nuisance impact to the land owner during construction periods. Gates left open by the access road users may cost the land owner time or money if livestock stray or are lost (see section 6.7., Socio Economic Concerns).

III. Recreation

The indirect impacts of a transmission line on recreation mostly affect the attitudes of the recreationists. For example, some users may consider the opening up of previously inaccessible land position, while others think it negative. Changes in recreational activities in some areas would take place, possibly displeasing some persons. It is also possible that some persons will stop using recreational facilities because of the visual presence of a transmission line.

Loss of natural environmental distinctiveness, caused by a transmission line, is a long-term indirect impact. The indirect social consequences are irreversible because the exact social condition can never be repeated.

6.5.6. Special Impacts

6.5.6.1. Bitterroot Valley Area

The settlements in the Bitterroot Valley range from that represented by Florence (1970 population; 45) to the urban area of Missoula (1970 population; 29,497, the largest city[8] within the Rocky Mountains. The area from Missoula south to Hamilton is interlaced with several small communities and subdivisions. A transmission line in this area would evoke two general viewpoints: (1) people should see the results of development (in this case, a transmission line), (2) people should not view objects that may cause psychological discomfort. Both of these reactions are discussed in the sections on Visual Concerns (6.4.) and Social-Economic Concerns (6.7.).

A transmission line through an industrial area in a large community would be more compatible than one through a smaller residential community that does not exhibit an industrial nature. Generally, then, impacts would be greater in smaller communities in the Bitterroot Valley.

The Bitterroot Valley from Florence south through Hamilton has generally been, until recent years, considered a rural agricultural area. Subdivisions, which contain over 50,000 acreas in Ravalli County (Environmental Information Center 1975), and residential populations (rural non-farm) have greatly infringed upon the agricultural area. Some fine irrigated and dry croplands have already been taken out of production, and additional irrigated and potentially irrigated lands would be lost if crossed by a transmission line. Dry cropland is somewhat more versatile in accommodating transmission lines, but because of potential losses of irrigated land from subdivisions in the Bitterroot Valley, dry cropland may become more valuable.

Recreation opportunities exist within the populated areas along the Valley floor and in areas of the Bitterroot National Forest surrounding the Valley. Impact on recreation would be minimal if these areas were circumvented.

6.5.6.2. Philipsburg Valley Area

Any loss of agricultural land in the Philipsburg Valley area would be a sizeable impact, as agriculture is the mainstay of this Valley's economy. Also, the use of sprinkler irrigation systems in the Valley is growing, and would be severely affected by a transmission line.

6.5.6.3. Georgetown Lake Area

Georgetown Lake is an area of intensive recreation. A transmission line would prevent recreational development in the right-of-way. A line placed adjacent to summer homes may cause decreased land values in the vicinity.

6.5.6.4. Anaconda Area

Since the Anaconda area is highly industrialized, the impact of a transmission line would be negligible.

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[8] Montana Environmental Indicators, Environmental Quality Council, Fourth Annual Report. December 1975.

6.5.6.5. Intermediate Area

The intermediate area contains three major types of land use: (1) logging, (2) mining, and (3) recreation. Generally, the proposed transmission line would not affect logging or mining operations. However, the whole Rock Creek drainage in the intermediate area is of high recreational value. Crossing Rock Creek at a right angle and at a lower use section where there are no campgrounds, fishing access sites, or other high activity areas would have small impact on the rest of the Rock Creek drainage.

The intermediate area also contains several roadless areas (see Recreation map). Access roads would irreversibly change their roadless character.

6.5.7. Criteria for Line Corridor Selection

The impact of the proposed transmission line on land use can be mitigated by circumventing certain areas or land use classifications. Possible mitigating measures for specific areas are presented below.

6.5.7.1. Bitterroot Valley

The Bitterroot River corridor contains several small communities, subdivisions, recreational sites, and historical sites. These are best avoided. It is also advisable to circumvent all irrigated lands and dry croplands. Adverse impacts can be minimized by following established corridors whenever possible (e.g., existing utility lines, gasline rights-of-way, and roads).

6.5.7.2. Philipsburg Valley

The whole valley floor consists of irrigated land, dry cropland, and potentially irrigated land. As such, these lands are highly valuable to the area's agricultural economy, and should be circumvented by a transmission line.

6.5.7.3. Georgetown Lake

Aesthetic value in this area would be maintained by siting a line away from home areas and Georgetown Lake proper. There is also a historical area, which also includes two ski areas, east of Georgetown Lake (see Recreation map). This area should be avoided in transmission line routing.

6.5.7.4. Anaconda Area

The use of existing corridors in this industrialized area would be the most desirable method of accommodating a new transmission line.

6.5.7.5. Intermediate Areas

If the Rock Creek recreational corridor cannot be circumvented, impacts can be minimized by crossing at a low use area. All roadless areas should be avoided. The use of established corridors to the greatest extent possible always minimizes adverse impacts.

6.6. Effects on Terrestrial Fauna

6.6.1. Introduction

Two conflicting viewpoints dominate current thinking in relation to the importance of wildlife. One viewpoint holds that wildlife is a commodity or resource which exists primarily to be exploited, and is important only to the extent that it is of direct benefit or detriment to man. The other is that wildlife is an integral part of a community of interrelated living things, and has an ecological "importance" which far outweighs any economic value to man. From either viewpoint, wildlife is accepted as an important concern, and land use decisions which may affect wildlife deserve careful consideration.

This section describes the wildlife concern as it relates to the proposed Anaconda-Hamilton 161 kV transmission line. In the following discussion, species and areas of concern within the study area will be identified, and ways of mitigating potential adverse impacts will be described.

6.6.2. Identification of Species of Concern

A great number of wildlife species, from land snails and insects to birds and mammals, are found within the study area. Not all of these species, however, are of equal concern in the siting and impact evaluation of the proposed Anaconda-Hamilton 161 kV transmission line. The following parameters were used to ascertain species of greatest concern in the present study.

6.6.2.1. Likelihood of Impact

Only populations of species which are in danger of being adversely affected by transmission line-related impacts are considered in this study. An adverse impact to wildlife may be defined as any environmental change which results in a departure of population levels from the optimum number of animals which the environment can support (that is, a departure from the "carrying capacity" of the environment). Possible adverse impacts can be categorized into four major groups: (1) habitat alteration, (2) displacement, (3) mortality, and (4) stress. Some of the major causal relationships among these four groups of impacts are shown in Figure 6-2. A detailed analysis of general impacts of transmission lines upon wildlife can be found in the Department's 1976 Draft EIS for the Clyde Park-Dillon 161 kV and 69 kV transmission lines project. The discussion which follows is a brief summary of the more important types of adverse impacts which may result from the proposed Anaconda-Hamilton 161 kV transmission line.

I. Habitat Alteration

Habitat alterations which detrimentally affect habitat quality can reduce carrying capacity and result in decreased numbers of animals. The major alteration of habitat is expected to result from the clearing of timber and construction of access roads through forests. This may degrade the habitat of forest-loving species of the study area, such as the red-backed vole, marten, and fisher, and may also reduce available cover for elk, moose, and deer.

The immediate impact of small-scale timber clearing on affected species is not expected to be great, and may not result in immediate and obvious reductions in animal numbers, but should not be disregarded. Piecemeal erosion of habitat is too often ignored, although it places irreversible constraints on the future abundance and distribution of animals, and may become significant as further habitat alteration due to other causes (such as clearcut logging, urgan and industrial expansion) continues.

On the other hand, bird diversity is likely to increase as a result of increased "edge" created by right-of-way clearing, and large herbivores such as elk, deer, and bighorn sheep may use forage found in the right-of-way.

II. Displacement

Displacement is a special type of habitat alteration which causes animals to avoid an otherwise suitable area. This may result from human activity, unfamiliar noises or objects, or vehicular traffic. Displacement may be either short-term or long-term.

Short-term displacement of large mammals (notably elk, deer, moose, and mountain goats) by disturbances such as timber clearing or road construction is well-documented, and can be expected to occur as a result of transmission line construction through forested areas. Displacement may be evident, in the case of elk, up to four miles from the site of disturbance. Most animals displaced by construction can be expected to resume normal activity once construction is completed. However, birds such as the osprey, golden eagle, and great blue heron may permanently abandon historical breeding sites if disturbed repeatedly by nearby construction early in the breeding season. Such abandonment may curtail the current year's production of young.

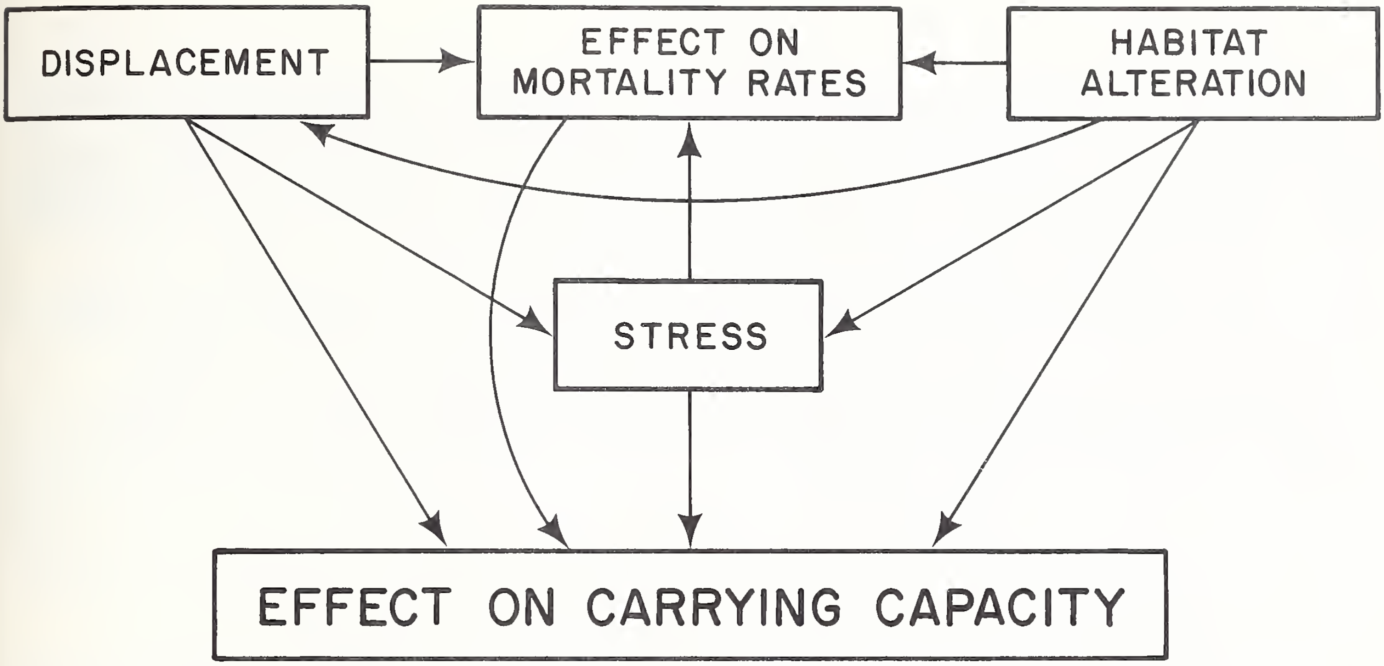
DISPLACEMENT
EFFECT ON MORTALITY RATES
HABITAT ALTERATION
STRESS
EFFECT ON CARRYING CAPACITY

Figure 6–2

Long-term displacement, or the permanent avoidance of a disturbed area, may be equivalent to a reduction in carrying capacity in the sense that previously-used areas are essentially made unavailable to the animals. Large mammals apparently are not displaced by the presence of energized transmission lines, although there is some evidence that the lines may be avoided by waterfowl. Long-term displacement of large mammals may result, however, from avoidance of human activity and vehicular traffic if the proposed line opens new access roads through unroaded areas. Some roadless areas remain on the Sapphire Divide. This poses a relatively high potential for adverse impact to the large mammals of the study area, although impact may be prevented if roadless areas are avoided in corridor selection, or if roadless construction methods are employed.

III. Mortality

Transmission lines are unlikely to cause direct mortality of most terrestrial wildlife species. However, collisions with power lines have been known to result in mortality of waterfowl and a wide variety of other birds, especially during windstorms, snowstorms, or periods of heavy fog when visibility is reduced. Waterfowl losses to wire strikes may be locally heavy if the line is placed near areas of high waterfowl use, such as the Ravalli National Wildlife Refuge. Slight increases in mortality rates of many species may result from illegal shooting by construction crews or persons using access roads.

Increased mortality is normally compensated for by increased birth rates, and populations depleted by mortality can be expected to eventually recover. Consequently, slight increases in mortality rates of animal populations are generally insignificant. Exceptions are species which are exceedingly rare or which have a very low reproductive potential (these will be discussed in Section 6.6.2.4.), or instances where mortality is heavy and continued.

IV. Stress

Stress may increase in animals affected by displacement or habitat alteration, and although this may not directly kill the animals, it may predispose them to mortality from other causes (such as disease, starvation, predation, or exposure). Even the slight increases in stress resulting from disturbance by construction or human use of access roads may be significant in the case of wintering ungulates, which may already be under severe stress.

6.6.2.2. Value

Many biologists feel that wildlife values, however important, are essentially unquantifiable. For example, placing a dollar value upon a glimpse of a wolverine in a winter forest, or an ecological value upon a pollinator such as the honeybee would be difficult at best. At least two measures of value to man, however, have been quantitatively estimated and give an approximation of the relative value of game species. These are: (1) resource value, which is proportional to the number of pounds of a particular game species harvested annually, and (2) hunting recreational value, which is proportional to the number of days spent annually in the pursuit of a particular game species (see Table 6-4). The elk has the highest resource value, as well as the highest hunting recreational value, of all game animals of the study area.

6.6.2.3. Status

The U.S. Bureau of Sport Fisheries and Wildlife, in its 1973 "Red Book," has identified certain species of animals as endangered, threatened, or status-undetermined. Although the classifications reported in the Red Book have been supplanted by the Endangered Species Act of 1973, they still provide a good relative index of vulnerability to extinction, and, although no longer legally valid, will be used here to identify species of concern.

The only endangered species known from the study area is the peregrine falcon; reports of gray wolves are unconfirmed. The peregrine falcon passes through the study area during migration, and although it has previously nested in the area, no currently active eyries are known. The threatened prairie falcon also occurs in the study area, but, like the peregrine falcon, is not likely to be adversely affected by the proposed line. Several status-undetermined species occur in the study area: the marten, fisher, wolverine, lynx, ferruginous hawk, osprey, merlin, and long-billed curlew. The fisher, once extinct from Montana, has been successfully reintroduced in the Sapphire Mountains, and a small population is known to exist there today.

6.6.2.4. Populations and Population Dynamics

I. Worldwide Abundance

Species which are exceedingly rare, whether formally classified as endangered or not, are susceptible to rapid extinction if mortality rates are suddenly increased, or if habitat is destroyed. Of the species found in the study area, only the peregrine falcon, trumpeter swan, and bighorn sheep have worldwide abundances estimated at less than 100,000 individuals.

II. Reproductive Potential

Populations of animals having a low reproductive potential are relatively slow to recover from population losses, and may not be able to fully compensate for heavy and continued mortality with increased reproductive rates. If populations are small, such species are highly vulnerable to local or regional extinction. Species in the study area having a relatively low reproductive potential are the black bear, marten, fisher, wolverine, mountain lion, elk, moose, mountain goat, bighorn sheep, and most large raptors. The reproductive potential of invertebrates, reptiles, amphibians, and most smaller birds and mammals is sufficiently high for populations to recover from even heavy mortality in a relatively short time.

TABLE 6-4

SUMMARY OF 1974 HARVEST DATA FOR BIG GAME ANIMALS OF THE ANACONDA-HAMILTON STUDY AREA

Species	Hunting Districts Within Study Area	Estimated Number Harvested	Estimated Biomass Harvested, Lbs.	Estimated Hunter Days	Relative Resource Value[1]	Relative Recreational Value[2]
Elk	210,211,212,213,214,216 230,240,260,261,270	1155	808,500	90,733	5	5
Mule Deer	210,211,212,213,214,216 230,240,260,261,270	1549	309,800	62,000	2	3
White-Tailed Deer	210,211,212,213,214,216 230,240,260,261,270	798	119,700	31,940	1	2
Mountain Goat	212,222,240,261,270	79	15,800	717	1	1
Moose	210,211,212,214,230,240 260,270	58	52,200	925	1	1
Bighorn Sheep	213	8	1,600	70	1	1
Black Bear	210,211,212,213,214,216 230,240,260,261,270	51	15,300	-	1	1
Mountain Lion	210,211,212,213,214,216 230,240,260,261,270	8	800	-	1	1

SOURCE: Montana Department of Fish and Game.

[1] Biomass/161,700 (rounded to nearest non-zero integer).

[2] Hunter Days/18,147 (rounded to nearest non-zero integer).

6.6.2.5. Distribution

I. Pattern of Distribution

Populations of widespread and wide-ranging species, such as the robin and coyote, are in little danger of being affected by site-specific disturbances such as transmission line construction. Breeding sites (such as osprey nests and heron rookeries), however, or seasonal concentration areas (such as elk and deer winter ranges) are much more likely to be affected by local disturbances, and are of greater concern in this study.

II. Restriction of Distribution

Species, races, or subspecies of animals which are largely confined to the study area are of special concern, since their elimination from the study area would mean total extinction. The only vertebrate taxa known to be restricted to the Anaconda-Hamilton Study Area are two endemic subspecies of mammals. These are *Thomomys talpoides confinus*, a subspecies of the northern pocket gopher restricted to the Bitterroot Valley near Hamilton, and *Eutamias amoenus vallicola*, a subspecies of the yellow-pine chipmunk known only from the vicinity of the Bitterroot Valley and Skalkaho Canyon. However, it is unlikely that these small mammals will be significantly affected by the proposed facility, and, hence, they are not of concern in this study.

6.6.2.6. Summary of Species of Concern

Major species of concern in the Anaconda-Hamilton study area which have been identified by the above considerations are listed in Table 6-5 below. For convenience of discussion, they have been divided into two groups: (1) species for which concern exists only at specific isolated sites, and (2) species for which concern exists over broader areas. Inventory data for these species of concern is summarized in Table 6-6.

TABLE 6-5

SPECIES OF CONCERN

Species	Sites or Areas of Concern
1. Species for which concern exists only at specific, isolated areas:	
Great Blue Heron	Rookeries
Sharptail Grouse	Dancing Grounds
Osprey	Nest Sites
Golden Eagle	Nest Sites

TABLE 6-5 (continued)

Species	Sites or Areas of Concern
2. Species for which concern exists over broader areas:	
Waterfowl	Breeding areas and areas of concentration during migration
Black Bear	Yearlong range
Marten	Yearlong range
Fisher	Yearlong range
Wolverine	Yearlong range
Mountain Lion	Yearlong range
Lynx	Yearlong range
Elk	Summer-fall range and winter-spring range
Mule Deer	Winter-spring range
White-tailed Deer	Winter-spring range
Moose	Winter-spring range
Mountain Goat	Yearlong range
Bighorn Sheep	Yearlong range

6.6.3. Mitigation of Potential Impacts

6.6.3.1. Mitigation at the Level of Corridor Selection

Corridor selection can mitigate impacts to wildlife only in the very broad sense that if the areas of greatest impact potential are avoided, the potential for impact to species of concern is reduced. Generally, mitigation at the level of centerline selection or construction is more important than corridor selection, although the location of the corridor may determine the relative need for mitigation at both levels.

In order to represent the concern of least impact upon terrestrial fauna in the corridor selection matrix described in Chapter Two, a map of the study area was prepared which broadly identifies areas of greatest wildlife impact potential. The methodology used in preparing this map (the "Wildlife Composite" map) involved the following steps:

(1) Each species of concern was assigned a numerical weighting, based upon relative value, status, worldwide abundance, reproductive potential, and likelihood of impact. The rating scale used to obtain these weightings is given in Table II in Appendix E.

TABLE 6-6

Summary of Inventory Data For Species of Concern, Anaconda-Hamilton Study Area

Species[1]	Preferred Habitat	Distribution within the study area	Major Food Sources	Classif., Status[2]	Remarks	Sources
Great Blue Heron (Ardea herodias)	Rivers, streams, marshes, mudflats	Widespread[3]	Fish, frogs, crustaceans, mice, insects	N	Breeds in colonies, usually in tall cottonwood groves along major rivers. Colonies (rookeries) known from the Bitterroot River near Hamilton, Stevensville. Migratory.	
Waterfowl[4]	Rivers, streams, lakes, ponds, adjacent grainfields	Widespread	Various	M	Includes several species of ducks, geese, and swans. Most abundant during spring and fall migrations, but many species remain through summer to breed. Highest concentrations along the Bitterroot River, especially at Ravalli National Wildlife Refuge.	
Golden Eagle (Aquila chrysaetos)	Open mountains, plains, foothills, canyons	Widespread	Rabbits, rodents	N	Several recently active nest sites are known within the study area.	
Osprey (Pandion haliaetus)	Rivers, lakes	Bitterroot River, Copper Creek	Fish	N, U	Several recently active nest sites have been located along the lower Bitterroot River and between Copper Creek and Moose Lake	
Sharp-tailed Grouse (Pedioecetes phasianellus)	Grassland, thickets, forest edges	Philipsburg valley; (formerly) Bitterroot valley	Grain, grasses	G	Relatively rare in the study area; no dancing grounds have been reported	
Black Bear (Ursus americanus)	Coniferous forests	Widespread	Various; includes grasses, carrion, mice, huckleberries, whitebark pine nuts	G	Found in relatively small numbers throughout the Sapphire, Bitterroot, and Flint Creek ranges. Overwinters in dens November - April.	Jonkel and and Cowan 1971; Tisch 1961
Marten (Martes americana)	Old-growth coniferous forests	Widespread	Red-backed and meadow voles, tree squirrel	F, U	A "climax forest species"	Koehler et.al. 1975; Weckwerth and Hawley 1962
Fisher (Martes pennanti)	Remote coniferous forests	Bitterroot Mts., Sapphire Mts.	Small mammals, birds, carrion	F, U	Once extinct from Montana; has been successfully re-introduced in the Sapphire Mts.	Weckwerth and Wright 1968
Wolverine (Gulo gulo)	Remote coniferous forests; tundra	Bitterroot Mts., Sapphire Mts., Flint Cr. Mts.	Carrion, snowshoe hares, rodents	N, U	Nearly extirpated from Montana in the early 1900's; has reoccupied much of former range	USDI 1974; Hornocker and Hash 1974
Mountain Lion (Felis concolor)	Remote mountainous areas	Widespread	Mule deer, elk	G	Occurs in very low densities in the study area	Hornocker 1970; Seidensticker et. al. 1973
Lynx (Lynx canadensis)	Taiga-like forests	Widespread	Snowshoe hares, birds, rodents	N, U	Much rarer in western Montana than the bobcat (Lynx rufus)	

TABLE 6-6 (continued)

Species[1]	Preferred Habitat	Distribution within the study area	Major Food Sources	Classif.. Status[2]	Remarks	Sources
Elk (cervus canadesis)	Grassy, wind-blown ridges and south-facing slopes (winter), moist drainage heads and grassy openings in high forests (summer)	See Figure 2	Variable; usually forbs and grasses (summer), browse and bunchgrasses (winter)	G	Movement to winter range begins with first heavy snowstorms of fall (usu. Nov.-Dec.). Return to summer range usually occurs in May and June. Calves are born in May and June near upper edge of winter range.	Cross 1965; Snyder 1969; Marcum 1975; Beall 1974; Stehn 1973; Bohne 1974; Lemke 1975; Zahn 1974.
Mule Deer (Odocoileus nemionus)	Burns, grassy south-facing foothills (winter) coniferous forests (summer)	Widespread in summer; see Figure 3 for winter distribution	Browse (winter), Browse and forbs (summer)	G	Arrive on winter range December to February; return to summer range March - April.	White 1960; Klebenow 1965; Asher 1951; Bailey 1960; Fairman 1966; Knoche 1968.
White-tailed Deer (Odocoileus virginianus)	Cottonwood forests, alfalfa fields, Douglas-fir forests	See Figure 4	Snowberry, Cottonwood, alfalfa, forbs	G	Less abundant than the mule deer	Allen 1968
Moose (Alces alces)	Willow bottoms and adjacent coniferous forests	See Figure 5	Willows and other browse	G	Highest densities in the study area are found in the willow bottoms of Upper Rock Creek	Stone 1971; Smith 1962; Schladweiler 1974
Mountain Goat (Oreanmos americana)	High cliffs, ridgetops, adjacent forests	See Figure 6	Grasses, sedges, rushes, forbs, browse	G	Prefers higher elevations but occurs along the low cliffs near Lost Creek State Park	Casebeer 1948; Chadwick 1973; Rideout 1974
Bighorn Sheep (Ovis canadensis)	Bunchgrass with nearby cliffs and timber (winter); high ridges (summer)	See Figure 7	Grasses (winter), Grasses, browse, and forbs (summer)	G	The Rock Creek population declined to as few as two in 1974; a 1975 transplant of 30 in this area has increased to at least 42.	Alderhold 1972; Berwick 1968; Cooperrider 1969

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[1] Nomenclature follows the American Ornithologists' Union Check-list (1957, 1973) and Hall and Kelson (1959).

[2] F = Furbearer, G = game species, M = migratory waterfowl, N = nongame species (as classified by the Montana Dept. of Fish and Game 1974); U = status undetermined (as classified by the U.S.B.S.F. & W. 1973).

[3] "Widespread" indicates wide distribution in areas of suitable habitat throughout the study area.

[4] For convenience, the many species of ducks, geese, and swans found in the study area which share similar distributions and habitat requirements have been considered as a group. A list of waterfowl species known from the study area and the known breeding status of each species is given in the appendix.

TABLE 6-7

WILDLIFE HABITAT CATEGORIES

No.	Category	Component Land Use Categories or Habitat Types
1	Man-altered Land	Urban, Small Communities, Scattered Built-up Areas, Industrial
2	Large Water Areas	Large Water Areas
3	Agricultural	Irrigated Cropland, Dry Cropland, Bottomland Mix
4	Bunchgrass	Grassland
5	Cottonwood	Cottonwood
6	Timber/Bunchgrass	PF/Agsp, PP/Agsp, DF/Agsp, PF/Juco, DF/Aruv
7	PP-DF/Shrub	PP/Syal, DF/Vaca, DF/Phma, DF/Vagl, DF/Syal, DF/Spbe
8	DF/Grass and Forb	DF/Xete, DF/Libo, DF/Caru, DF/Cage
9	Lodgepole Pine	Lodgepole Pine Series
10	AF-GF Dry	DF/Xete, AF/Vaca, AF/Xete, AF/Vagl, AF/Vasc, AF/Caru
11	AF-GF Moist	GF/Clun, AF/Clun, S/Gatr, AF/Gatr, Pi/Gatr, AF/Caca, AF/Libo, AF/Mefe, AF/Alsi, Pi/Libo
12	Subalpine and Timberline	AF(WBP)/Vasc, AF/Luhi, WBP-AF, AL-AF, WBP
13	Scree and Rock	Rock, Forested Rockland, Scree
14	Willow and Alder Flats	Meadow, Alder Glades, Willow
15	Logged	Logged

(2) Those areas of concern listed in Section 6.6.2.6. for which distribution information is available were mapped (see accompanying maps).

(3) A map showing major wildlife habitat categories was prepared by combining appropriate categories from the land use map and an unpublished vegetation habitat types map (Table 6-7). This Wildlife Habitat map can be found in the pocket at the back of this publication.

(4) Each habitat category was rated according to its potential habitat suitability for each species of concern. The criteria for rating are shown in Table III of Appendix E, and the actual ratings used in this study are given in Table IV of Appendix E.

(5) The distribution maps, together with the numerical weightings of species of concern, were combined by computer with the map of habitat categories and with the appropriate habitat suitability ratings, producing a composite map. Species for which areas of concern have not been mapped were assumed to occur in areas of suitable habitat throughout the study area.

(6) A map of existing transmission lines, paved and gravel roads, urban areas, and industrial areas was prepared and combined with the composite map. It was assumed that existing disturbances to wildlife in these areas reduce the probability that a new 161 kV line or new access roads would further affect wildlife.

(7) The values of each unit on the resulting map were scaled from 0-4, according to Table 6-8 to produce the Wildlife Composite map.

TABLE 6-8

WILDLIFE UNIT VALUES

Range of Summed Values[1]	Scaled Value	Impact Category
0 Wmax/5	0	Zero or negligible impact potential
(Wmax/5)+1 - 2Wmax/5	1	Slight but significant impact potential
(2Wmax/5)+1 - 3Wmax/5	2	Moderate impact potential
(3Wmax/5)+1 - 4Wmax/5	3	Large impact potential
(4Wmax/5)+1 - Wmax	4	Severe impact potential

[1] Wmax is the highest numerical weighting received by any unit.

6.6.3.2. Mitigation at the Level of Centerline Selection

Centerline selection allows a more precise level of impact mitigation than does corridor selection. Many possible adverse impacts to wildlife can be mitigated by choosing a centerline which:

(1) Avoids the sites of concern identified in section 6.6.2.6.

(2) Avoids other sites which are locally valuable to species of concern, such as willow bottoms, security areas, or winter concentration areas

(3) Makes use of existing access roads so that new roads need not be built

(4) Crosses or closely parallels areas which are avoided by species of concern (such as large clearcuts or industrial areas), or where the species of concern are already somewhat habituated to human activity (such as in the vicinity of major paved and gravel roads)

(5) Makes use of existing forest clearings or non-timbered areas so that extensive right-of-way clearing is not necessary

6.6.3.3. Mitigation at the Level of Construction

Proper methods and timing of transmission line construction may be more important than the geographical loaction of the route itself. Impacts of transmission line construction through a given area can be greatly mitigated in many cases, even if the corridor or centerline crosses areas of extremely high impact potential.

Many of the possible construction-related impacts to wildlife can be mitigated by:

(1) Prohibiting construction through seasonal use areas or in the vicinity of breeding sites during seasons when the sites are occupied (see Figure 6-3)

(2) Prohibiting off-raod travel by construction crews and their vehicles

(3) Planning construction, when seasonal use areas or breeding sites cannot be avoided, so that construction can be accomplished as quickly as possible, perhaps by scheduling double work shifts in these areas

(4) Employing roadless construction methods, such as helicopter construction, where the centerline crosses forested roadless areas

TIMES OF ACTIVITY OR GREATEST SENSITIVITY TO DISTURBANCE AT SEASONAL USE AREAS IN THE ANACONDA—HAMILTON STUDY AREA

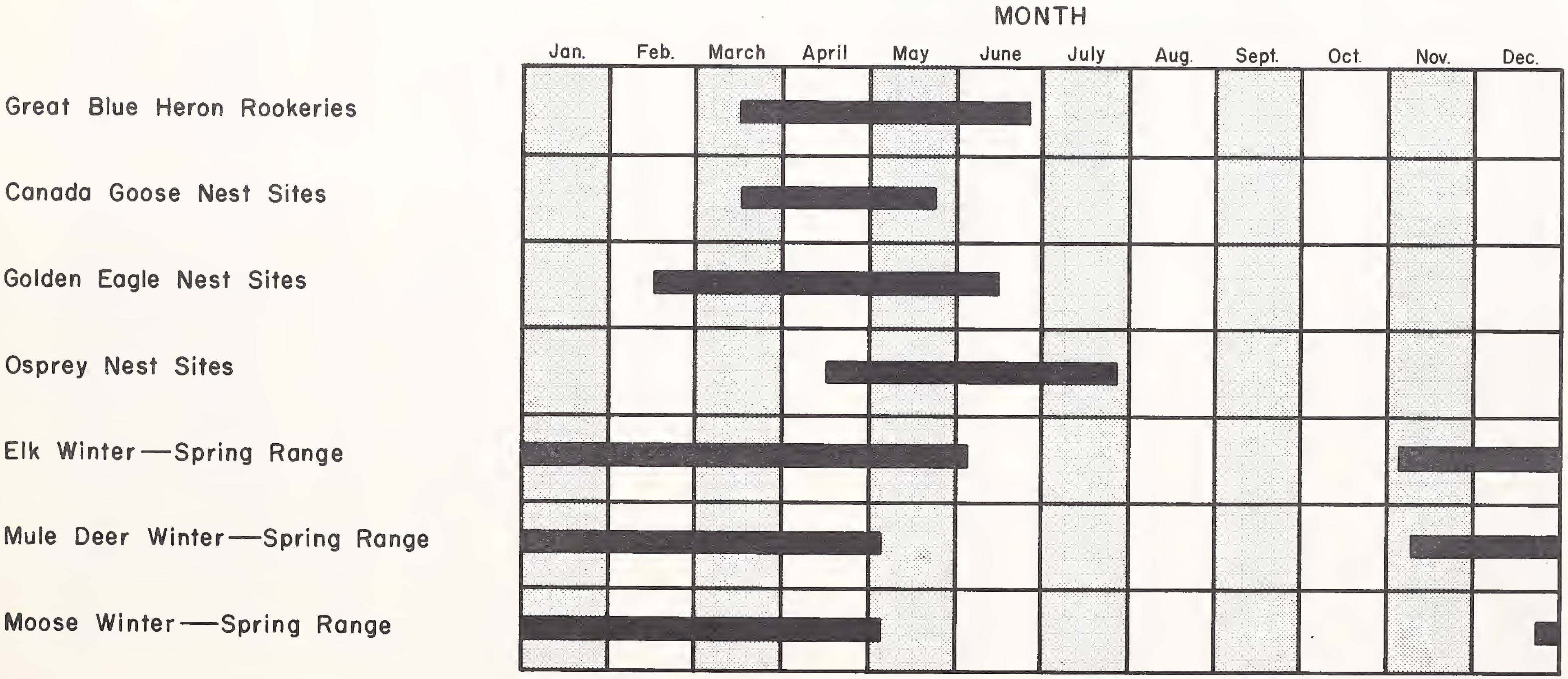
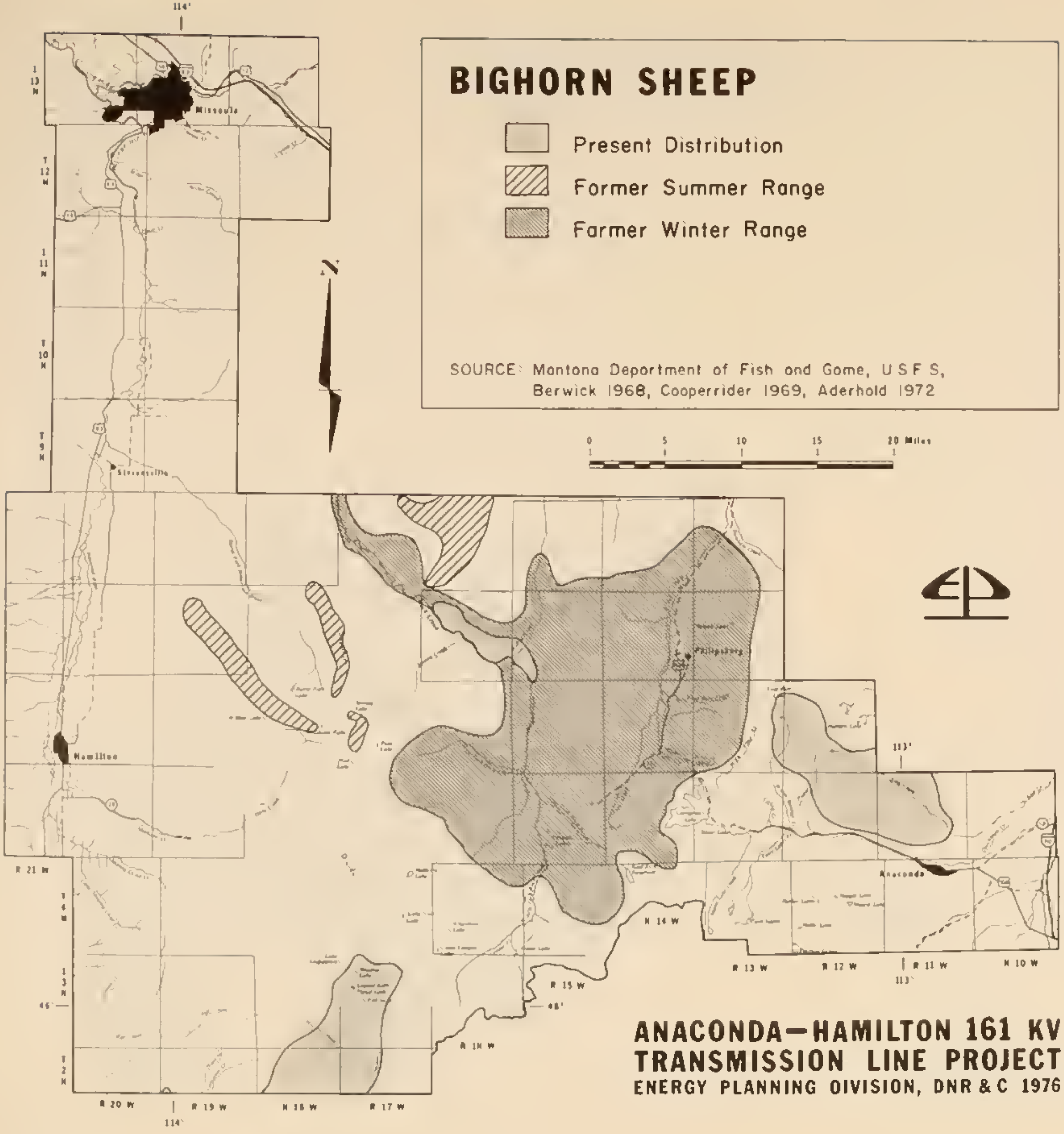


Figure 6–3



BIGHORN SHEEP

▢ Present Distribution
▨ Former Summer Range
▨ Farmer Winter Range

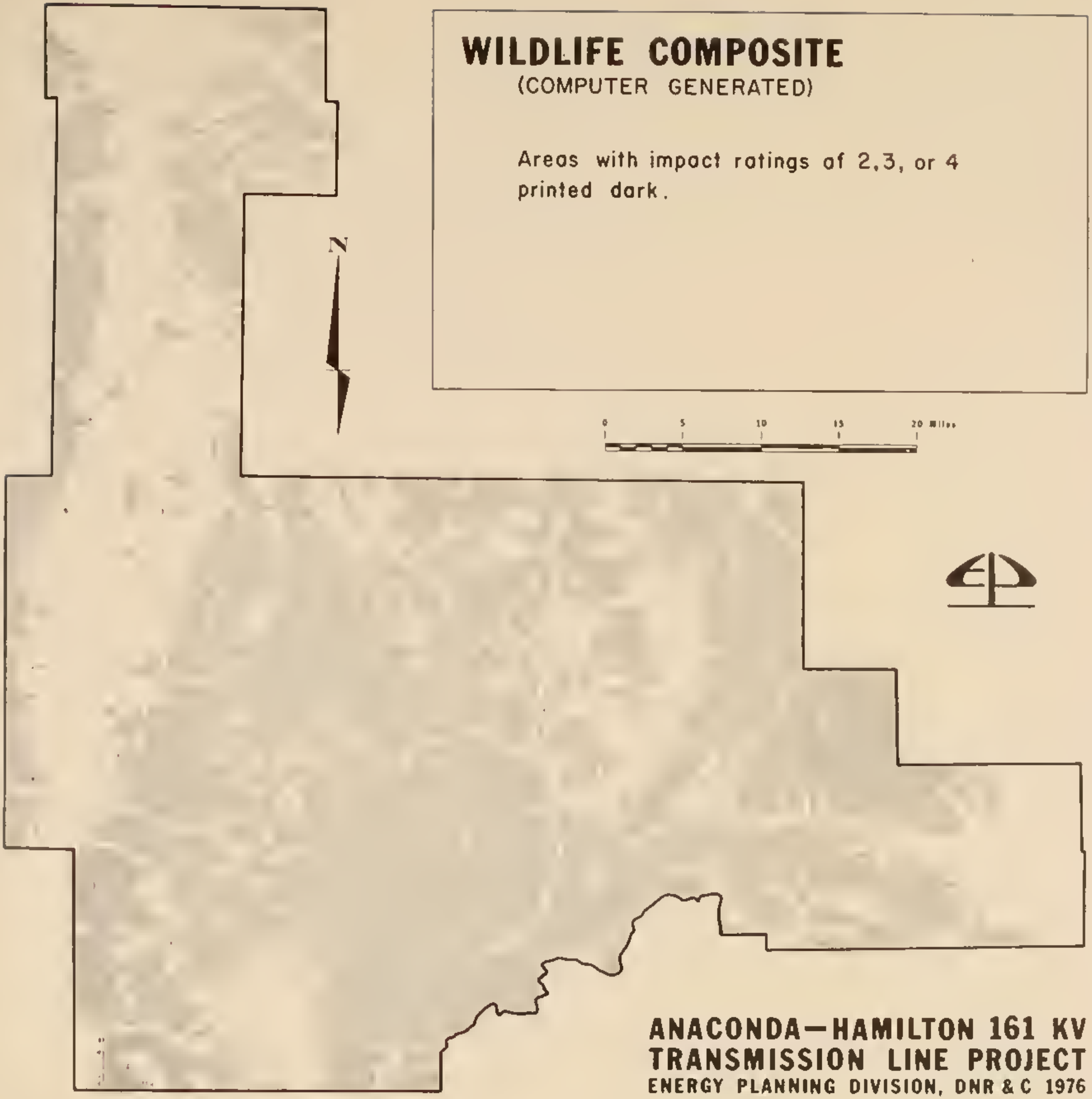
SOURCE: Montana Department of Fish and Game, U.S.F.S., Berwick 1968, Cooperrider 1969, Aderhold 1972

ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976

WILDLIFE COMPOSITE

(COMPUTER GENERATED)

Areas with impact ratings of 2,3, or 4 printed dark.



ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

WILDLIFE COMPOSITE

(COMPUTER GENERATED)

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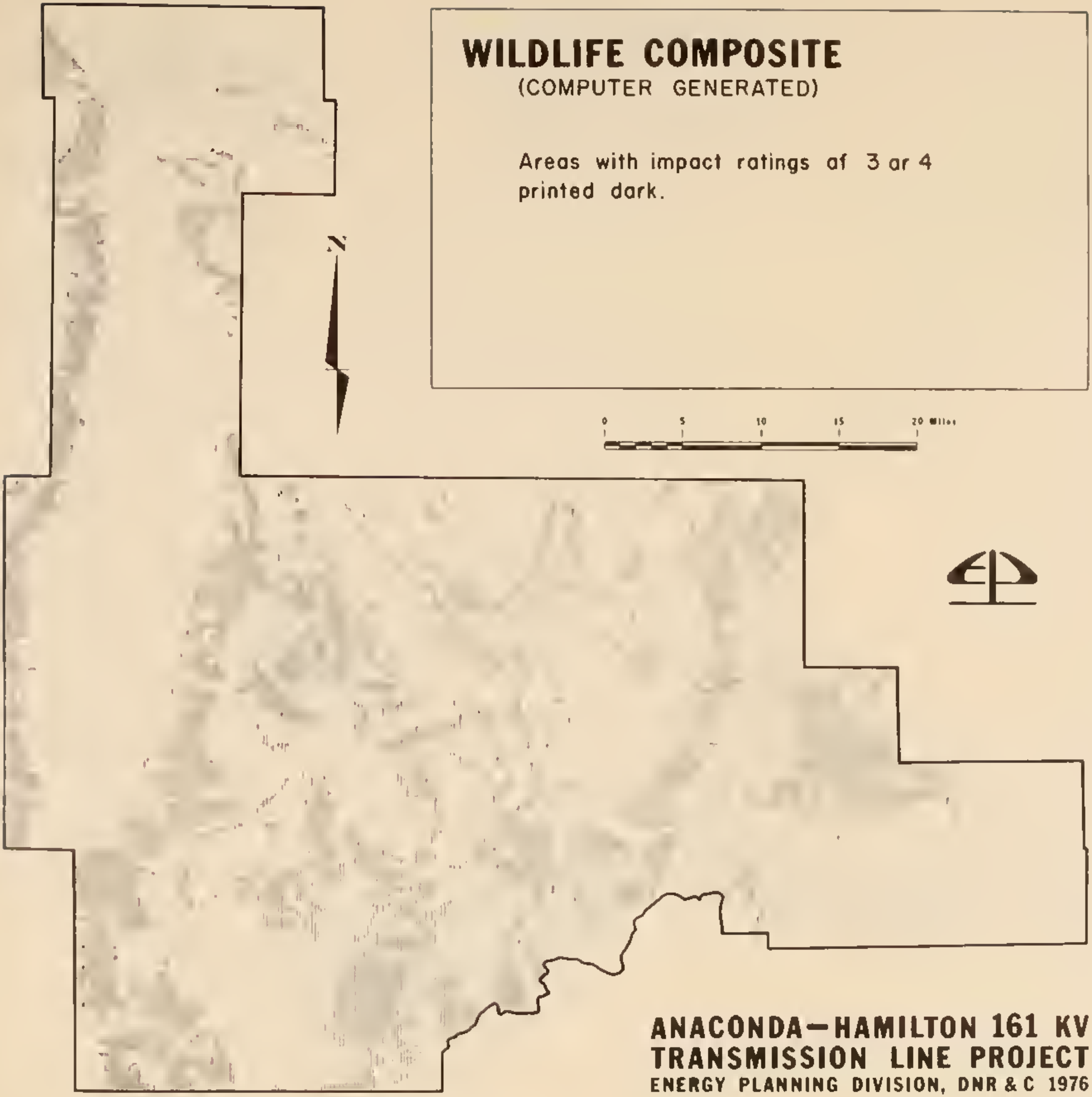
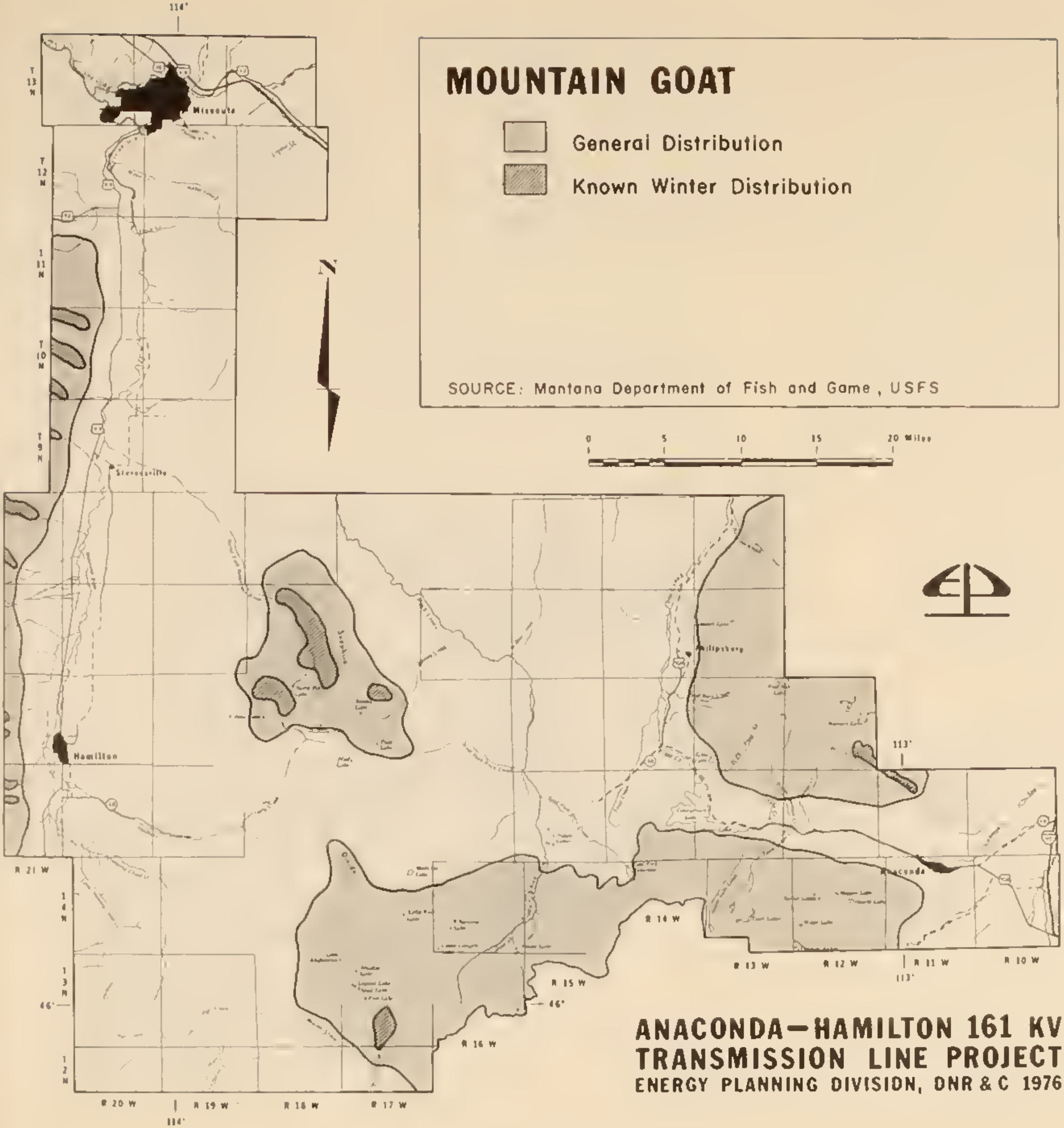


ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976



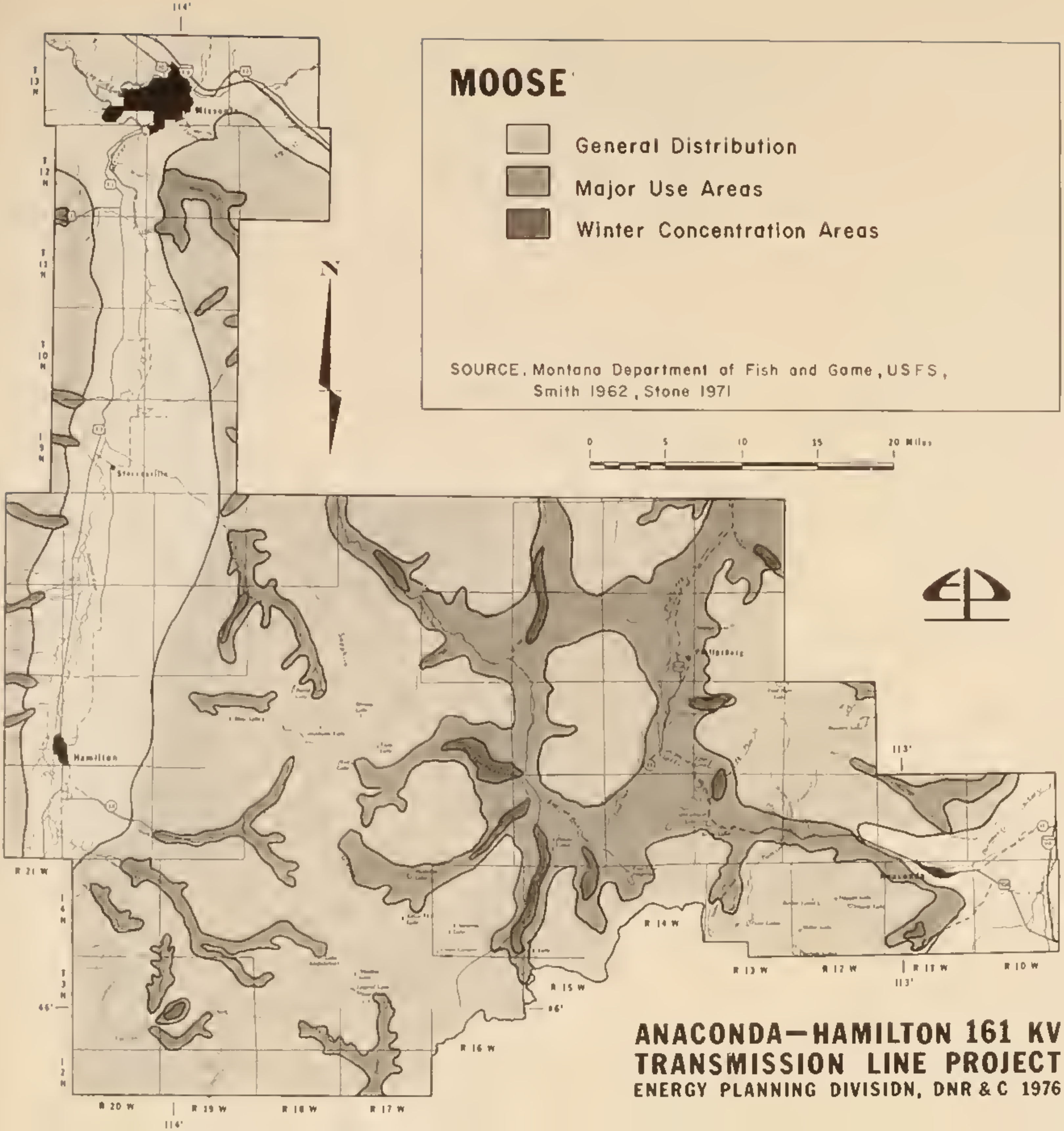
MOUNTAIN GOAT

▢ General Distribution

▨ Known Winter Distribution

SOURCE: Montana Department of Fish and Game, USFS

**ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976**



MOOSE

- ▢ General Distribution
- ▨ Major Use Areas
- ■ Winter Concentration Areas

SOURCE. Montana Department of Fish and Game, USFS,
Smith 1962, Stone 1971

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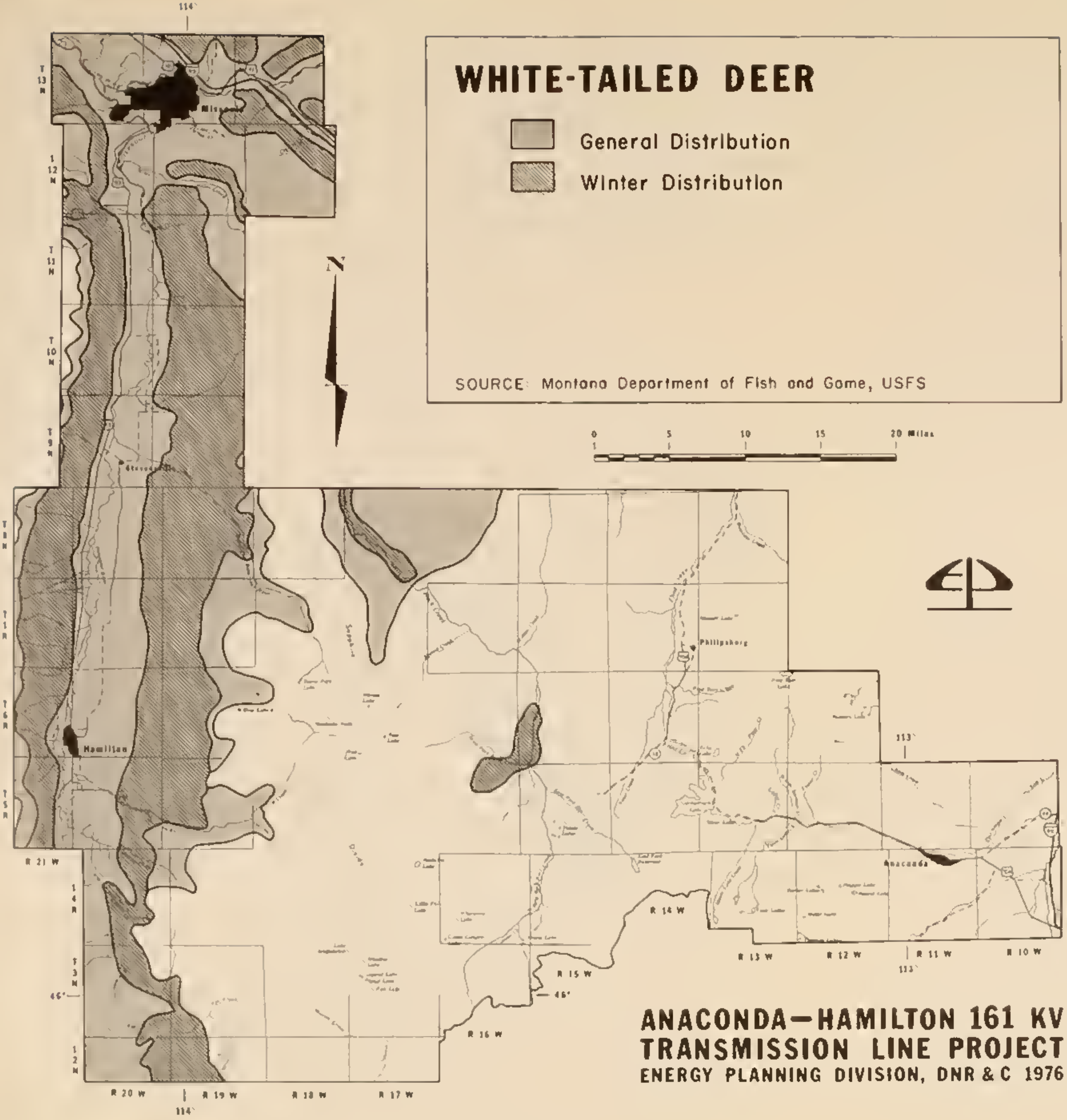


WHITE-TAILED DEER

▢	General Distribution
▨	Winter Distribution

SOURCE: Montana Department of Fish and Game, USFS

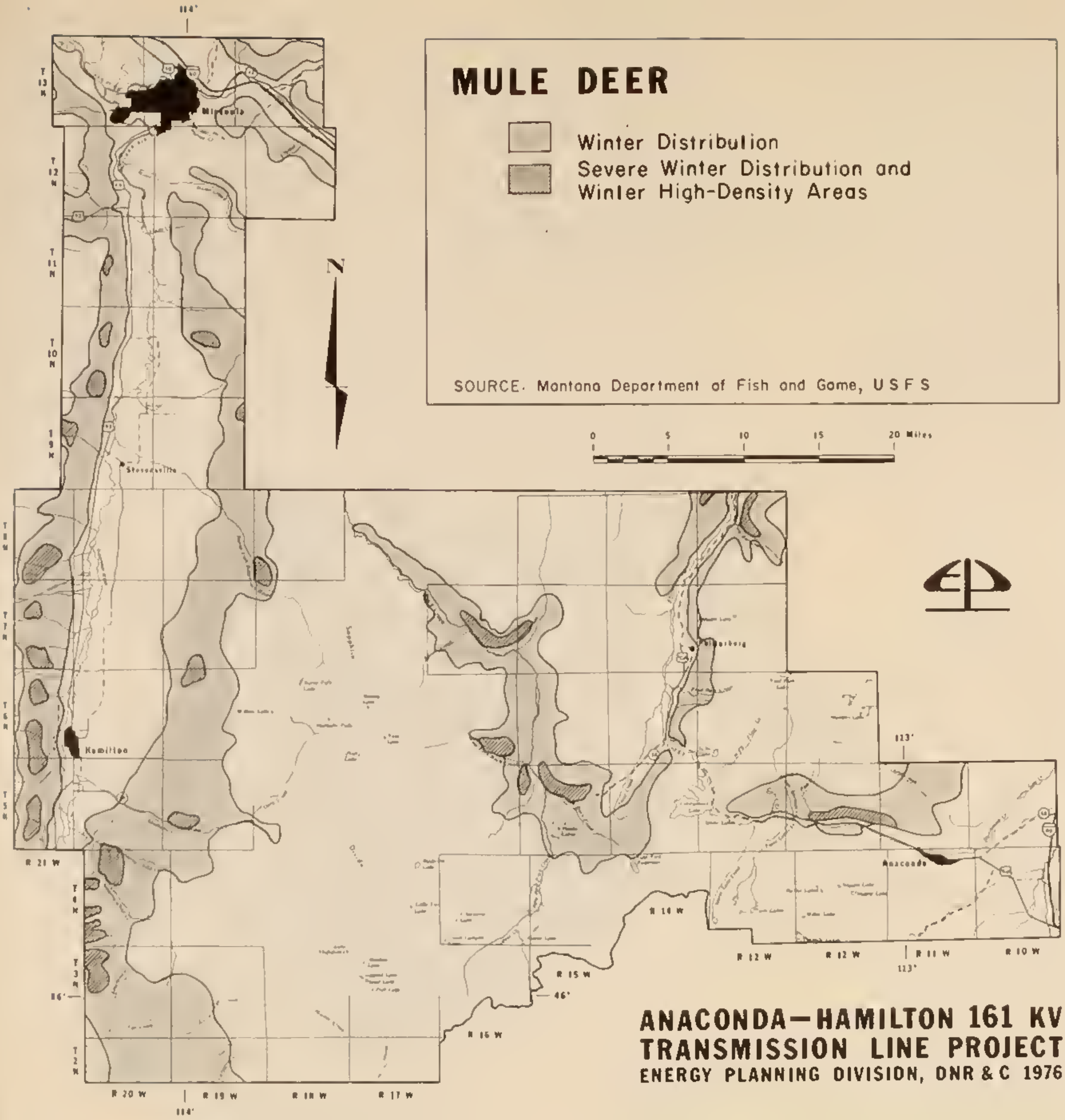
ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

MULE DEER

- ▭ Winter Distribution
- ▨ Severe Winter Distribution and Winter High-Density Areas

SOURCE: Montana Department of Fish and Game, USFS



ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

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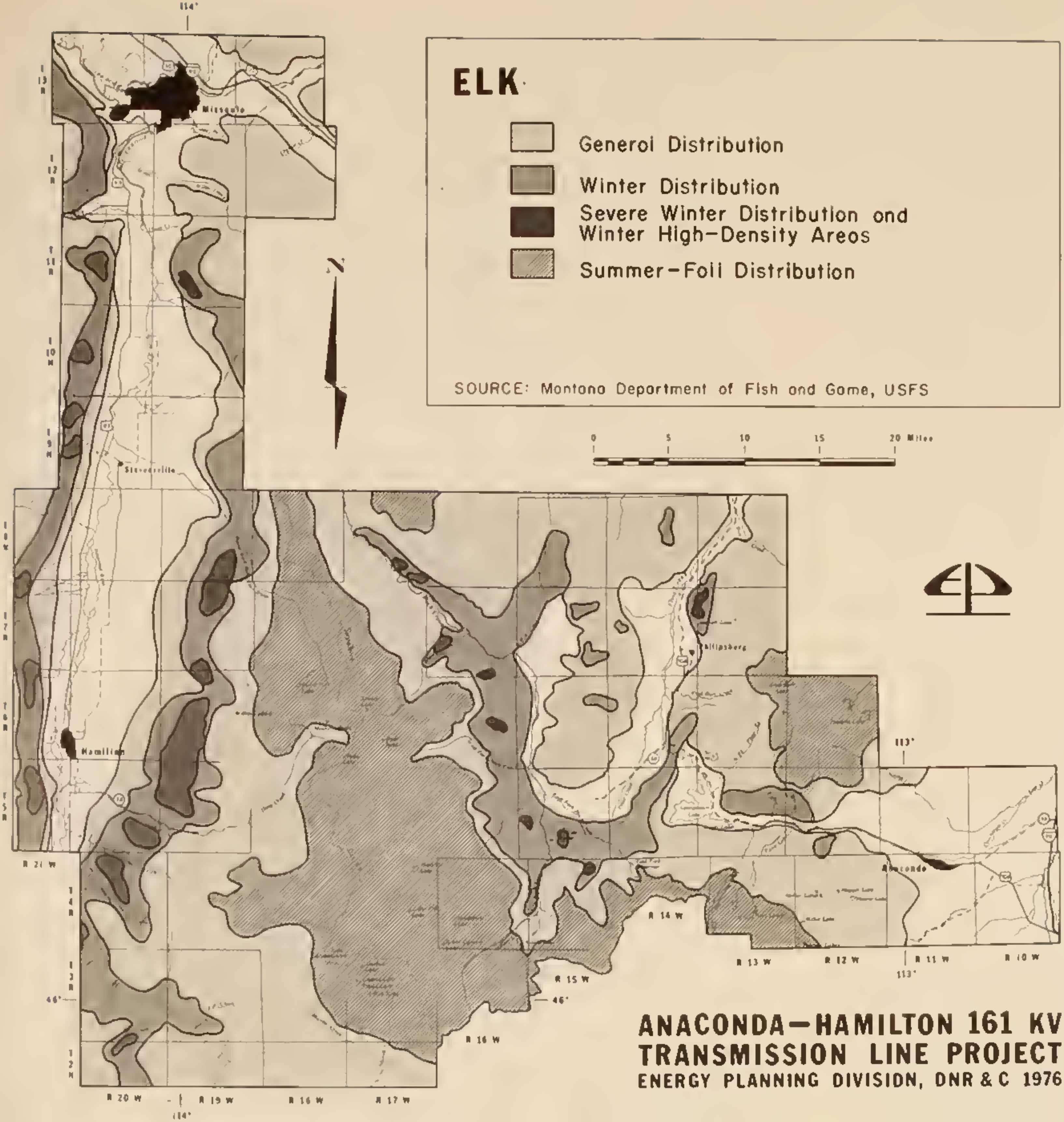


ELK

- ▢ General Distribution
- ▩ Winter Distribution
- ■ Severe Winter Distribution and Winter High-Density Areas
- ▨ Summer-Fall Distribution

SOURCE: Montana Department of Fish and Game, USFS

ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

(5) Limiting right-of-way clearing to the minimum necessary for line stringing and line clearance, and by "feather-cutting" rather than block-clearing of the right-of-way

(6) Closing and posting new access roads

Experience has shown that many of these mitigating measures may be impractical or impossible to enforce. For example, closing and posting access roads does not guarantee that they will not be used by determined hunters. This must be kept in mind when evaluating the relative importance of mitigation at the level of construction.

6.7. Socio-Economic Concerns

6.7.1. Introduction

Social and economic impacts refer to any beneficial or detrimental effect on the social structure of a community, on social values, on an individuals quality of life, or on the economic circumstances of individuals, businesses, and communities. In many environmental assessments, immediately recognizeable and quantifiable impacts receive more attention than effects less quantifiable or which may become apparent only at some future time. Though difficult to evaluate, such intangible impacts are an integral part of man's social structure and an effort must be made to define and understand them.

A rural state with low population and numerous natural attributes, Montana attracts a variety of people with divergent interests, personal values, and lifestyles. Conflicts of interest exist between people who desire an urban lifestyle in a rural setting and people who are opposed to any urban-like development which may degrade Montana's environmental quality. A balance between quality of life, as perceived by each individual, and natural resource utilization is indeed difficult to achieve and maintain. In light of this problem, the following examines potential immediate and long-term impacts of the proposed transmission line upon the social and economic conditions of the study area.

6.7.2. Social and Economic Characteristics of the Study Area

Montana's economic and social development has been influenced, in part, by its natural setting. The fur trade of the 1840's marked the white man's first attempt to make a living in Montana. This enterprise was followed by a series of spectacular booms, i.e., precious metal mining, copper mining, livestock raising, and finally dry-land farming. This last boom was the most tenuous, and the agricultural depression of the 1920's and 1930's led to a general economic malaise.

Slow, steady declines in agriculture and mining, balanced by a similar growth rate in tourism and forestry, have resulted in an economy more static than the "boom or bust" eras. Though less dependent on the ups and downs of single industries, economic decline has been steady, and Montana is in a slump relative to the national economy. For example, in 1950, Montana's per capita personal income was 8% above the national average. In 1968, it had dropped to 14% below the national average, and in 1975, it was 7% below the national average (Department of Community Affairs, personal communication). Slow income growth has been accompanied by an unemployment rate usually above one percentage point above the national average (University of Montana 1970). Economic conditions of the study area, in general, reflect state-wide conditions. Social and economic characteristics of the Anaconda-Hamilton study area are discussed below and presented in Table 6-9.

6.7.2.1. Population

Population densities in Missoula and Deer Lodge Counties, despite their rural land use character, are considerably higher than the state average of 4.8 people/square mile (see Table 6-9). Industrial and university activities in the cities of Missoula and Anaconda account for the comparatively high densities. Spill-over from the Missoula area and the attractiveness of the Bitterroot Valley to people of retirement age have raised the density of Ravalli County above the state average. Having no major urban influence, Granite County has maintained a low density.

Population of the study area is distributed among three categories (see Table 6-9). Urban areas contain 2,500 people or more. Rural non-farm populations contain less than 2,500 people who reside outside city limits. Rural farm populations live on farms.

Missoula and Deer Lodge Counties are predominantly urban. Granite and Ravalli Counties are classified as rural, the largest city being Hamilton with 2,499 people. The majority of the Deer Lodge County population lives in a narrow corridor along U.S. Highway 10-A from Opportunity to Georgetown Lake; 62% of the residents inhabit Anaconda (Northwest Planners, Inc. 1973). Missoula County has 56% of its population living in Missoula, and Philipsburg contains 41% of the Granite County population.

Missoula and Ravalli Counties grew between 1960 and 1970, but Deer Lodge and Granite County populations declined (see Table 6-10). Missoula County had the largest net gain, with increases in all three population categories. Though Granite County had the highest percentage loss, Deer Lodge County suffered the largest actual net migration.

TABLE 6-9

SOCIO-ECONOMIC STATISTICS OF THE ANACONDA-HAMILTON STUDY AREA

	Deer Lodge County	Granite County	Missoula County	Ravalli County
POPULATION (1970)				
urban	9,771	0	43,531	0
rural farm	344	476	1,060	2,667
rural non-farm	5,541	2,400	13,766	11,736
total	15,656	2,876	58,357	14,403
density-people/sq. mi.	21	2	22	6
land area-sq. mi.	740	1,733	2,612	2,382
EMPLOYMENT (1970)				
agric. & forestry	355	194	1,140	1,182
manufacturing	1,788	184	2,588	632
mining	179	36	21	14
construction	146	141	1,289	247
educational services	323	68	3,473	411
public administration	174	50	775	85
retail trade	657	76	4,056	859
others	1,670	189	8,007	1,415
unemployed: (national average=5.6%) (state average = 7.4%)				
INCOME (1970)				
per capita (national ave.=$3,506) (state ave.=$2,712)	$2,288	$2,500	$2,999	$2,314
median family (national ave.=$9,590) (state ave.=$8,512)	$8,275	$7,132	$9,066	$7,137

SOURCE: Montana County Profiles, Department of Community Affairs, 1973 and U.S. Department of Commerce, 1975.

TABLE 6-10

POPULATION CHANGES, ANACONDA-HAMILTON STUDY AREA, 1960-1970

	Deer Lodge Co.	Granite Co.	Missoula Co.	Ravalli Co.
Urban				
1960	12,060	0	30,907	0
1970	9,771	0	43,531	0
Percentage change	-19	0	+41	0
Rural farm				
1960	280	711	563	3,813
1970	344	474	1,060	2,875
Percentage change	+23	-33	+88	-25
Rural non-farm				
1960	6,318	2,303	12,192	8,527
1970	5,541	2,380	13,766	11,528
Percentage change	-12	+3	+13	+35
Net	-2,722	-160	+14,695	+2,063

SOURCE: Montana County Profiles, Department of Community Affairs, 1973.

Population losses between 1960-1970 in Deer Lodge and Granite Counties were due to declines in mining, manufacturing, timber industry and agricultural employment. Growth increases in Ravalli and Missoula Counties during the same period were attributed to growth of the University of Montana in Missoula. Also, as the largest city in the Rocky Mountains, Missoula offers urban job opportunities in a rural mountainous setting.

The four counties had total gains of 10,335 and 3,875 people in urban and rural non-farm populations, and a loss of 614 people from the rural farm populace, emphasizing the trend in the area to live in or near urban areas.

6.7.2.2. Employment and Income

Agriculture, mining, metal processing, forestry, and tourism are all important to the economy of the study area. Agriculture accounts for 37% of the jobs in Ravalli County. In fact, the county is twice as dependent on agriculture for employment as is the whole state. Despite the economic importance of agriculture to Ravalli County, people are leaving the farms, and land is being divided into small rural non-farm units. Also, small farms are being incorporated into large ones with a subsequent decline in agricultural employment. This decline is expected to continue as more people settle in the area. However, the major economic activities in Ravalli County are associated with the lumber industry and the city of Missoula. A growing population will strengthen such an economic base (Morrison-Maierle, Inc. 1972).

Agriculture is the major use of land in Deer Lodge County (62% of the total acreage). However, few people are employed by agriculture, as the tendency there is also toward fewer and larger farms and ranches. Deer Lodge County is economically dependent on Anaconda as 48% of the population is employed in manufacturing (USDA n.d.). Major manufacturing operations include lime and rock quarries, concrete product plants, and a copper smelter. The state hospitals at Warm Springs and Galen are also major employers in the county.

Logging and ranching are major occupations in Granite County. Recreational development is increasing in popularity, particularly in the Rock Creek drainage, and Georgetown and Echo Lake areas. Granite County has approximately equal numbers of people employed in the five occupational groups listed in Table 6-9. Such diversification provides some economic stability to the county.

Land ownership change has accelerated in the past five years in Missoula County, with a trend toward homesite development of agricultural land. An increasing population requires more services, and, thus, a large percentage of the county's population is employed in some facet of retail trade. The University, such manufacturing operations as the Hoerner-Waldorf Pulpmill, and lumbering industries in general employ a major portion of the population.

Though the study area is experiencing some rapid and drastic changes in land use which affect social and economic conditions, overall economic growth is slow. Income statistics for the area are indicative of this growth. With the exception of Missoula County, per capita and median family incomes are below the state and national averages (see Table 6-9).

6.7.2.3. Socio-Economic Setting

As with any location, there are nonpecuniary aspects of the study area which determine the residents' quality of life. The natural assets of recreation and uncrowded living conditions are attractive to many people; however, the social and economic cost of space is high. Low population density makes provision of adequate social services (medical treatment, education, etc.) expensive. In addition, since industries and businesses are not attracted to sparsely populated areas, job opportunities are minimal. Consequently, some residents of economically depressed counties in the study area "feel industry is needed to create more jobs, increase the population, and broaden the economic base (USDA n.d.). An example of these sentiments is illustrated in a quote from the Granite County Situation Statement (1972):

> Though much of the land in Granite County is mountainous it is felt there is more than enough room for economic development to improve living standards of the people.

Growth encouragement and desires for rural living have resulted in accelerated land ownership changes in the study area. Three of the four counties experienced increases in rural non-farm populations between 1960 and 1970 (see Table 6-10). Though some of this population change can be attributed to small farm absorption by large agricultural operations, subdivision has been multiplying since the mid-1960's. Between 1957-1972, 47 plats for subdivision were filed in the Bitterroot Valley. The transactions involved 2,116 acres, or 977 lots, averaging 2.2 acres/lot (Torgrimson 1973).

Success of economic growth cannot be measured solely by increases in employment and income. All ramifications of the growth must be considered, as the various interests at stake may conflict with one another. Economic decline may, in fact, be caused by growth which raised the area to an economic level it could not sustain (Rust *et al*. 1975). Philipsburg and Anaconda are communities founded on such unstable circumstances. When mining and mineral processing declined, depressed economic conditions resulted.

Accelerated growth and economic development carries the threat of environmental deterioration. Such threats are met with opposition to industrial expansion and population growth by some residents of the study area. In the early 1970's, a coalition of Bitterroot Valley land owners tried unsuccessfully to halt construction of a transmission line down the Valley's east side.

The urgency for organized control of rural development in the study area has been identified as illustrated in the following quote:

> In view of the potential for increased settlement in the Valley (Bitterroot) and the apparent inability of a decentralized market to bring about a consistently acceptable pattern of development, it would appear wise for residents of Montana's mountain valley areas to move ahead with deliberate action to protect their areas from the ravages of rapid and unguided growth (Hash, *et al*. n.d.).

Organizations such as the Bitterroot Resource Conservation and Development (RC&D) Project have been created to help regulate development. The RC&D Council encourages growth of small, light industries that strengthen the economy, while controlling haphazard urban sprawl, safeguarding the environment, and planning for future growth (USDA 1973).

6.7.3. Impacts

In order to determine whether construction of a facility is justified, costs and benefits are evaluated. Unfortunately, cost/benefit analyses are frequently short-sighted:

> . . . we need a system based on real or true economics. . We currently have a ledger system which is entirely based upon man, which is egocentric, and what we really should

> do is construct a balance sheet or ledger based upon all costs associated with the functioning of the biosphere, or individually upon entire ecosystems. When you do that, you end up with an honest balance sheet, in which you include all the ecological costs as well as the monetary cost of the product. Then more realistic ecological decisions can be made on whether some manipulation or endeavor is really economically feasible or worth it (Likens 1972).

Evaluation of all social and economic costs for the proposed facility requires consideration of tangible and intangible impacts. Tangible impacts are perceptible and usually quantifiable effects, such as loss of land to tower sites, right-of-way compensation, and electrical availability. Intangible impacts are those which become apparent at some time in the future or are generally unquantifiable. Intangible impacts are difficult to evaluate, may seem less important, and are frequently ignored in impact assessment.

6.7.3.1. Tangible Beneficial Impacts

I. Satisfaction of Electrical Demand and Reliability

Montana Power Company (MPC) has estimated that future needs of the study area justify the proposed line (see Chapter Three). Electrical demand is increasing in the study area, particularily in Missoula and Ravalli Counties, according to MPC. This increase is related to continuous expansion of the University of Montana and industrial activities, increasing use of irrigation pumping, and influx of new residents. The MPC estimates that electrical demand in the Bitterroot Valley will increase 8% from 1973-1985 (MPC 1974). The electrical load in Missoula County alone will probably double in the next 7-8 years (USDA 1972). If the proposed line meets electrical needs in the study area, then the facility represents a benefit to the consumer.

Electrical reliability can be very important to some customers. For example, assurance of outage-free electrical supply is economically beneficial to industrial customers without back-up systems.

II. Property Taxation

Property taxation will be the major beneficial fiscal impact of the line. MPC expects property taxes on the preferred route to amount to $29,400, based on 65 miles of line at a construction cost of $42,000/mile (see Table 6-11) However, tax allocation procedures are complicated (DNRC 1976), and taxable value of the line is essentially dependent upon the company's overall financial worth. Therefore, a truly accurate tax figure will not ba available until after construction. Of course, the county with the most mileage of line and/or highest mill rate, will receive the greatest return, and any amount will benefit the counties involved.

TABLE 6-11

ESTIMATED TAX (1975), ANACONDA-HAMILTON LINE

County	Miles	Installed Cost	Taxable Value	1975 Mill Levy	Total Tax
Deer Lodge	25	$1,050,000	$60,900	215	$13,100
Ravalli	16	672,000	38,976	174	6,800
Granite	25	1,008,000	54,464	163	9,500
	65	$2,730,000	$158,340		$29,400

SOURCE: Written communication, 8 March 1976, from the MPC to Department.

III. Power Company Return

Construction and operation of the new facility is a long-term investment for the utility company. Obviously, the company is expected to recover costs, but the company's rate base increase, if any, is presently unknown.

IV. Right-of-Way Payment

Line right-of-way procurement requires monetary compensation by the power company. A lump sum payment is made to private owners while a rental period, usually in five year increments, is established with the Forest Serivce. For example, the MPC pays the Forest Service $287.50/year for 10 miles of the Anaconda-Billings 161 kV line. This fee is based on 5% of the value determined by the number and type of pole settings. A similar rate was offered to land owners (Roginske, written communication). Though no figures have been made available for the Anaconda-Hamilton line, they are expected to be similar to those mentioned above. In the case of the Anaconda-Hamilton preferred route, a large portion of the reimbursement would be realized by the Forest Service, as 95% of the land crossed in Granite County and 80% of that crossed in Ravalli County is under its jurisdiction.

V. Employment Opportunities

The MPC expects the following personnel to be required for the proposed line:

a) 8 persons for surveying
b) 25 persons for right-of-way clearing and road construction
c) 27 persons for structure installation
d) 18 persons for wire stringing and clean up

Right-of-way clearing and road construction are estimated to take seven months, and structure and wire installation to take six months. Construction employees could expect the following hourly wages:

a) sawyer	$5.72
b) ground man	$6.46
c) lineman	$8.54
d) equipment operator	$8.83

Some local workers possessing the necessary skills and union membership may be hired for the project; however, most workers will probably come from outside the area. In any event, employment opportunities will be limited and short-term.

VI. Sale of Goods and Services

Many necessary construction materials are expected to be purchased through Montana distributors, but materials originating in Montana will not exceed 5% of the total line cost (MPC, written communication 1976). In addition, monetary reimbursement for sale of goods and services to construction and maintenance crews will be of limited short-term benefit.

6.7.3.2. Intangible Beneficial Impacts

I. Electrical Reliability

Though measureable as hours of outage-free electricity, the psychological effect of reliability is difficult to quantify. Certainly, reliable electricity is desirable to people living in cold climates who have electric heat.

II. Economic Security

Although the mere existence of electrical facilities does not guarantee prosperity, some security-conscious people may equate the two and, thus, receive a beneficial impact.

III. Aesthetics

Aesthetics are determined by personal values. To some people, the sight of transmission lines, and cities is pleasing.

6.7.3.3. Tangible Detrimental Impacts

I. Property Damage and Inconvenience

The potential exists for numerous impacts on personal property, as a result of line construction and maintenance. For example, straying of construction/maintenance crews from the right-of-way can result in additional damage to natural vegetation and crops. Because these damages are outside the right-of-way, they may be ignored during cleanup and reseeding. Also, incomplete removal of litter at tower sites can cost the landowner time and effort to remove. In addition, pieces of wire, nails, broken glass, etc., can represent health hazards to livestock. Gates left open by workers can result in straying livestock which may become lost, placing a financial burden on the owner. Radio and television reception for people living close to the line can be altered.

Except for the latter, property damages are short-term impacts easily avoided by respect of crews for owners' land and strict adherence to cleanup processes. People living near a line will apparently have to accept radio and television interference.

II. Reduced Land Value

Land with a line crossing it or land adjacent to a corridor may be irreversibly lowered in value. (However, reduced value may be beneficial if it results in lowered taxes).

III. Presence of Construction Workers

Because the number of workers entering the study area will be small, their impact on communities will be negligible and temporary. The workers will be like tourists in an area accustomed to such influxes.

IV. Electrical Rate Increase

Additional expenditures for increased electrical supplies must be added to the utility company's rate base, but whether a consumer rate increase is a consequence of the Anaconda-Hamilton line cost is unknown. The new line may possibly pay for itself without such increases; however, a line constructed solely to achieve reliability will probably result in a rate increase.

V. Loss of Land

Though the owner is monetarily compensated for line right-of-ways, the easement represents an irretrievable committment (unless the line is removed) of productive land. In addition to actual land removed from production, land usability may be altered or reduced. A farmer who uses or plans to install sprinkler irrigation may find that the line interferes with or prohibits such operations. Consequently, he may have to face a potential decrease in crop income.

Also, fearing that construction roads will create recreational accessibility, the land owner may begin posting formerly open land. In this case, the line would affect the recreationist.

6.7.3.4. Intangible Detrimental Impacts

I. Aesthetics

The construction of transmission line and access roads in roadless areas and recreation areas would be viewed as a negative impact by some people. Some other detrimental aesthetic impacts may include incomplete removal of construction litter.

II. Continued Environmental Deterioration

The construction of a transmission line, especially one built for reliability alone, will be viewed by some as representative of continued environmental impact within Montana.

Some people feel that utility companies justify construction of new power facilities by projecting need which may or may not occur in the future. These people feel that utility construction may induce development of an area, causing an increase in population and fulfilling the "projected" electrical need.

Opposition to this self-fulfilling prophecy is prevalent in the Bitterroot Valley because of concern for the future of the Magruder Corridor. The Corridor is a strip of relatively undeveloped land between the Selway-Bitterroot Wilderness and the Salmon River Breaks Primitive Area, and is a possible site for a transmission line from Montana to Idaho. People in the Valley feel strongly about protecting this area from future development and fear that a line from Anaconda-Hamilton will provide the impetus for construction in the Corridor (Schwennesen 1975).

6.7.4. Conclusions

Construction of the Anaconda-Hamilton 161 kV transmission line would both beneficially and detrimentally affect social and economic conditions of the area. In terms of tangible social/economic impacts, construction of the line probably would have relatively minor effects on the area. Although contributions to county tax bases would be welcome, such revenue will probably do little to change economic conditions of the study area. Intangible impacts vary in quality from aesthetic disapproval of construction processes to enhanced feelings of economic and personal security. Because intangible impacts are not easily defined, determination of their degree of importance relative to the Anaconda-Hamilton line is difficult. Still, the subtle nature of these impacts should not preclude their careful consideration.

Social, economic, and environmental goals are multifaceted and frequently inconsistent. The problem in any impact assessment is that of trying to weigh incommensurable costs and benefits. Attempts to balance economic benefits against indirect or unforeseen environmental degradation and subtle, indirect effects on human psychology are difficult. The following quote by M.H. Moskow (n.d.) summarizes the situation:

At bottom, the big questions about whether environmental goals justify their costs cannot and should not be answered by economists or by Federal bureaucrats. They are questions about social values, about people's preferences.... the most the economist can do is lay out the facts ..... the question, "Is it worth it?" . . . is a subjective decision and one which the public must make for itself.

CHAPTER SEVEN

SELECTION AND EVALUATION OF ALTERNATIVE CORRIDORS

7.1. Introduction

Chapter Two described how the Anaconda-Hamilton study was approached and the general methodology used. Chapter Six presented the basis and results of the studies related to each concern. This chapter will discuss how the alternative corridors in this study were selected and a comparison of identified corridors.

The two overlays of potential corridors, found in the back pocket of this publication, show tentative alternative corridors identified by the applicant (MPC) and the Energy Planning Division (EPD). These alternatives are presented here without preference, and will be evaluated later in this chapter.

The corridors shown on the overlays represent two possible system alternatives for supplying power to the Hamilton area. One of these connects the Anaconda-Hot Springs 230 kV transmission line near Bonner (point V on the overlays) with the proposed Hamilton Heights substation (point K) via the Bitterroot Valley. Two alternative corridors (both EPD routes) connecting these points are presented. The second system alternative connects the Anaconda substation (point A) with the Hamilton Heights substation by crossing the Sapphire Mountains. Several MPC and EPD alternative corridors are shown for this possibility.

In Table 7-2, alternative corridors are compared with respect to length or area included in several land use and impact risk categories. In the following discussion, areas with significant impact potential within each of the alternative corridors are identified with respect to each of the six concerns identified in Chapter Six. Since two-mile-wide corridors are being compared here, it is not feasible to predict the exact nature and magnitude of the actual impacts which would result from line construction within each alternative corridor, as actual impacts are dependent upon centerline location, methods of construction, timing of construction, and adherence to mitigating measures. Rather, this section addresses the potential for adverse impact within alternative two-mile-wide corridors, recognizing that potential impacts can in many cases be mitigated or prevented. Alternative corridors are treated in two groups below: (1) Anaconda-Hamilton, and (2) Bonner-Hamilton. Alternative corridors within each group will be described, potential for adverse impact to each concern will be assessed, and a brief summary of impact potential to each concern will be given.

7.2. Corridor Selection

The relationships of the various maps used in this study are shown in Figure 2-1. The composite maps generated by a computer, and shown at the bottom of Figure 2-1, were used by Department personnel to select the EPD alternative corridors shown on the overlay in the back pocket. Each of these maps is a composite of the seven concern maps--Aquatic Ecosystem Composite, Recreation, Wildlife Composite, etc.

In producing the composite maps, the computer averages the impact rating values of the seven concern maps, and rounds off to a whole number for each cell, except a cell represented by a rating of five (legally excluded) on any map, in which case it automatically becomes a five on the composite. The computer can also give more weight to some of the maps in its averaging. The ability to select weightings can allow the staff to emphasize some concerns and observe how selected emphases change the desirability of a given corridor. In selecting the EPD corridors shown on the overlay, the staff produced five composite maps using different weightings as shown in Table 7-1. The "unweighted" composite is a simple averaging process without weights assigned to the seven maps. Composite "A" is a weighting that was agreed upon by the staff as a good overall weighting. The other weightings emphasize cultural values, fish and wildlife, and productivity, respectively.

The computerized printer produces the maps in white and black only. A single composite is printed as a series because there is no way to distinguish the six impact value ratings. This series is shown by the computer-generated composites included within this chapter.

Since the computer is averaging values from other maps, there are few zero's and four's on the composites. As a result, two maps of the series of each composite contain most of the information on which to choose a corridor. These two are shown for the unweighted composite. Printed as they are, these composite maps show those areas more suitable for a transmission line in white. The reader can place the overlay over the composite maps in this report to observe how the alternatives appear.

It must be emphasized that staff members select the alternative corridors using professional judgements of the study area and the computer-generated maps. The computer does not and cannot produce any alternative corridors.

7.3. Potential Impacts for Alternative Corridors

7.3.1. Alternatives Connecting Anaconda to Hamilton

7.3.1.1. MPC Preferred Corridor

This corridor extends southeast from the Hamilton Heights substation site to Skalkaho Creek, then follows Skalkaho Creek and its tributary, Railroad Creek, to the Sapphire Divide. East of the Sapphire Divide, the corridor crosses Sand Basin, Moose Meadows, East Fork Reservoir, and continues to Anaconda along the lower slopes of the Anaconda Mountains. Forested lands are included in nearly every mile of this corridor.

A. Impacts to Aquatic Ecosystems. Most of this corridor crosses areas that have been identified as having a slight to moderate aquatic ecosystem impact

TABLE 7-1

WEIGHTINGS OF CONCERN MAPS

	Recreation	Wildlife Composite	Land Use Site Patterns	Visual Analysis	Agricultural and Range Productivity	Aquatic Ecosystems Composite	Forest Productivity
Unweighted Composite	1	1	1	1	1	1	1
Weighted Composite "A"	2	2	1	3	1	3	3
Weighted Composite "B"	4	3	4	5	2	2	2
Weighted Composite "C"	2	5	2	2	2	4	2
Weighted Composite "D"	1	2	2	2	3	2	5

NOTE: Weightings of the concern maps used to generate composite maps from which corridor alternatives were drawn. (Numbers in this table are the relative weightings used to form each composite map and can be compared only with the other numbers occurring in the same horizontal row.)

risk (see section 6.2.). However, two areas having large to severe impact risk are found within this corridor. The first of these is the area along Skalkaho Creek, from the confluence of Railroad Creek to the mouth of Fullerton Gulch (map points G-H). Along this section, limitations in line placement, aggravated by steep slopes adjacent the stream, increase the potential for construction-related impacts. Skalkaho Creek is an important sport fishery, containing several salmonid fish species.

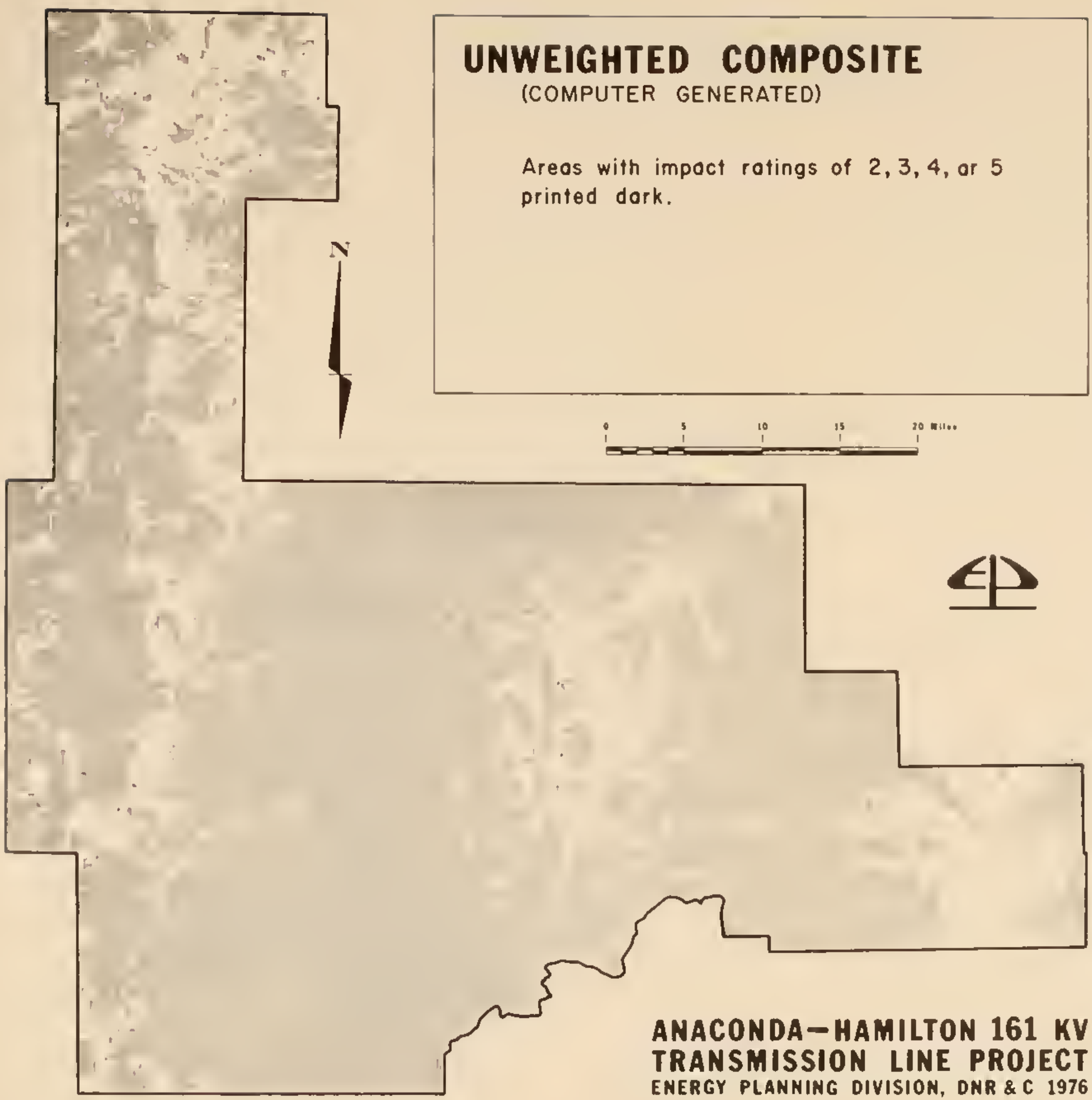
The second area of concern is the Sand Basin area high in the Sapphire Mountains (near map point F). This area has been identified as having a large to severe risk for transmission line-related aquatic ecosystem impacts. The area on the east side of Skalkaho divide includes the headwater regions for the West Fork of Rock Creek, and, on the west side of the divide, Railroad Creek, an important tributary of Skalkaho Creek. The extent that these areas are used for spawning and rearing by native salmonid fish species is unknown, but it is highly probable that the areas contain these sites. Erosion-related events caused by construction of a transmission line could result in adverse impacts to the fisheries of these areas. The USFS transmission line corridor erodibility hazard classification for this area is severe, and interpreted as "either technology is not available to overcome the limitation, or it is costly to apply. The land should not be allocated to the use unless there is no alternative" (see section 6.2.).

B. Impacts on Land Productivity. This corridor has the potential for comparatively large impacts on forested land. Situated in national forest land from Twin Lakes Creek (west of Anaconda) all the way to Gird Creek (southeast of Hamilton), it traverses an area of almost continuous forest.

West of the Sapphires, this corridor passes through areas of high productivity near Railroad Creek and Skalkaho Creek, and traverses a large amount of forest in segment H-K. East of the Skalkaho divide, much of the potential for significant impact on forest productivity is due to the location of this line in forest land in the East Fork Rock Creek - West Fork Rock Creek area. Since the corridor traverses no cultivated land except possibly in the vicinity of the proposed Hamilton Heights substation site, impacts on agricultural productivity are expected to be insignificant, as are impacts to rangeland.

C. Visual Impacts. The MPC preferred corridor crosses areas of large visual impact potential over most of its length. These areas are closed-canopy coniferous forests (primarily national forests), and right-of-way clearing would result in a highly visible configuration. Some areas of severe visual impact potential are also included in this corridor. These are the roadless areas atop the Sapphire Divide and south of Black Bear ranger station, and the recreation areas near East Fork Reservoir.

D. Impacts on Land Use Patterns. The major problem area in the applicant's preferred corridor is the area known as Railroad Pass on the Sapphire Divide. This is a designated roadless area and also is included in the Montana Wilderness Bill (S.B. 393). Construction of a transmission line through this



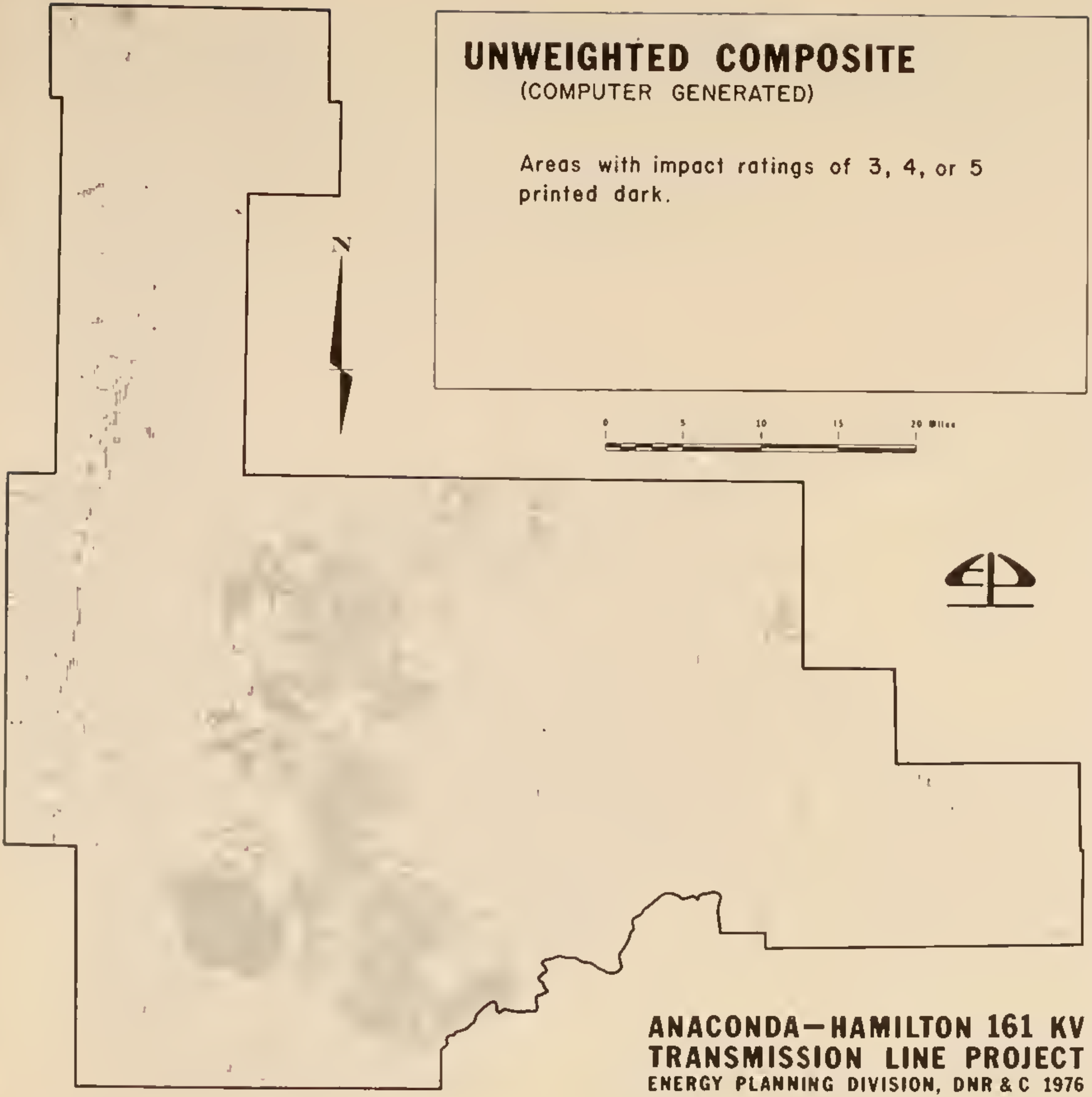
UNWEIGHTED COMPOSITE

(COMPUTER GENERATED)

Areas with impact ratings of 2, 3, 4, or 5 printed dark.

ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976



UNWEIGHTED COMPOSITE

(COMPUTER GENERATED)

Areas with impact ratings of 3, 4, or 5 printed dark.

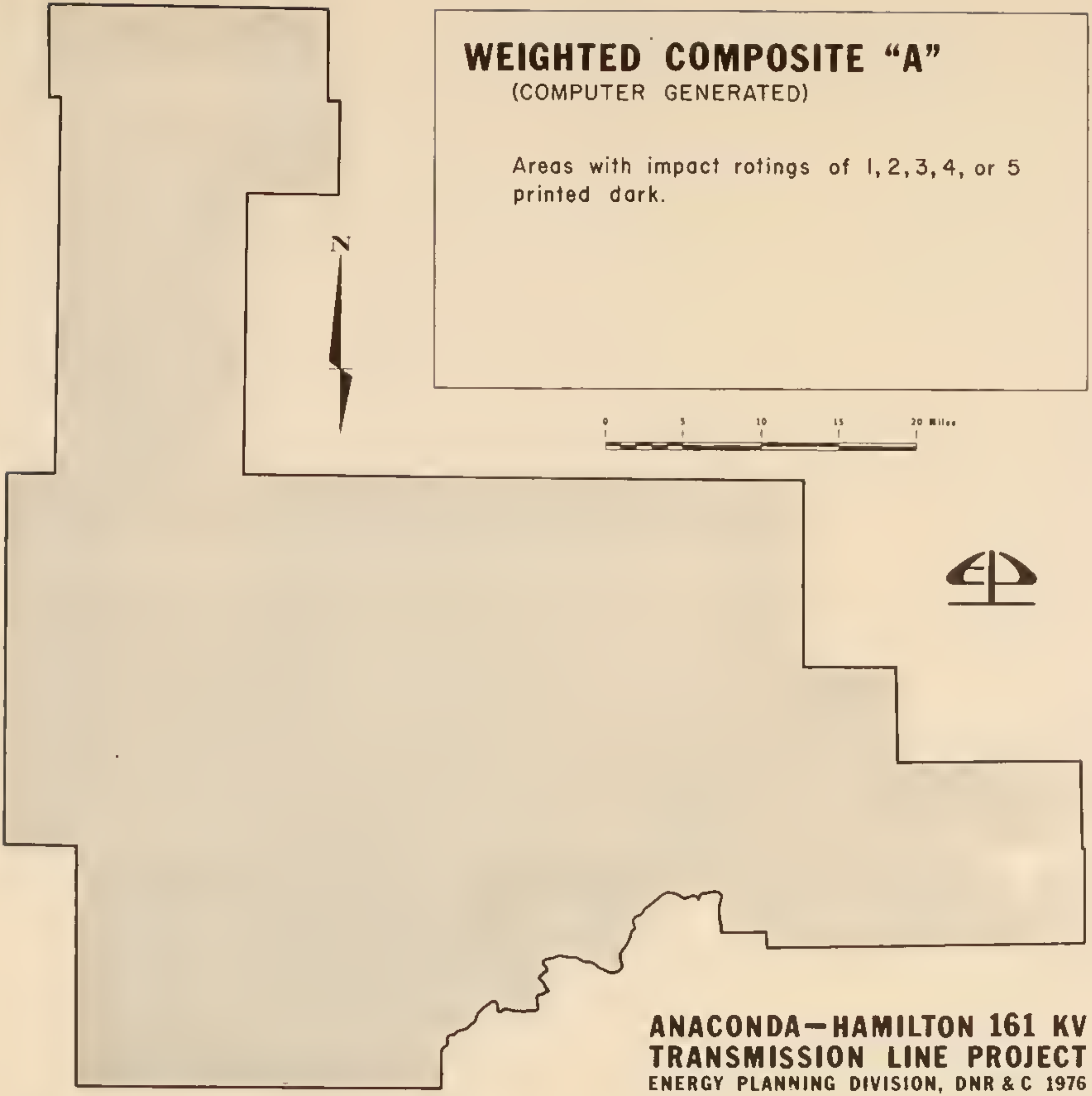
ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

WEIGHTED COMPOSITE "A"

(COMPUTER GENERATED)

Areas with impact rotings of 1, 2, 3, 4, or 5 printed dark.



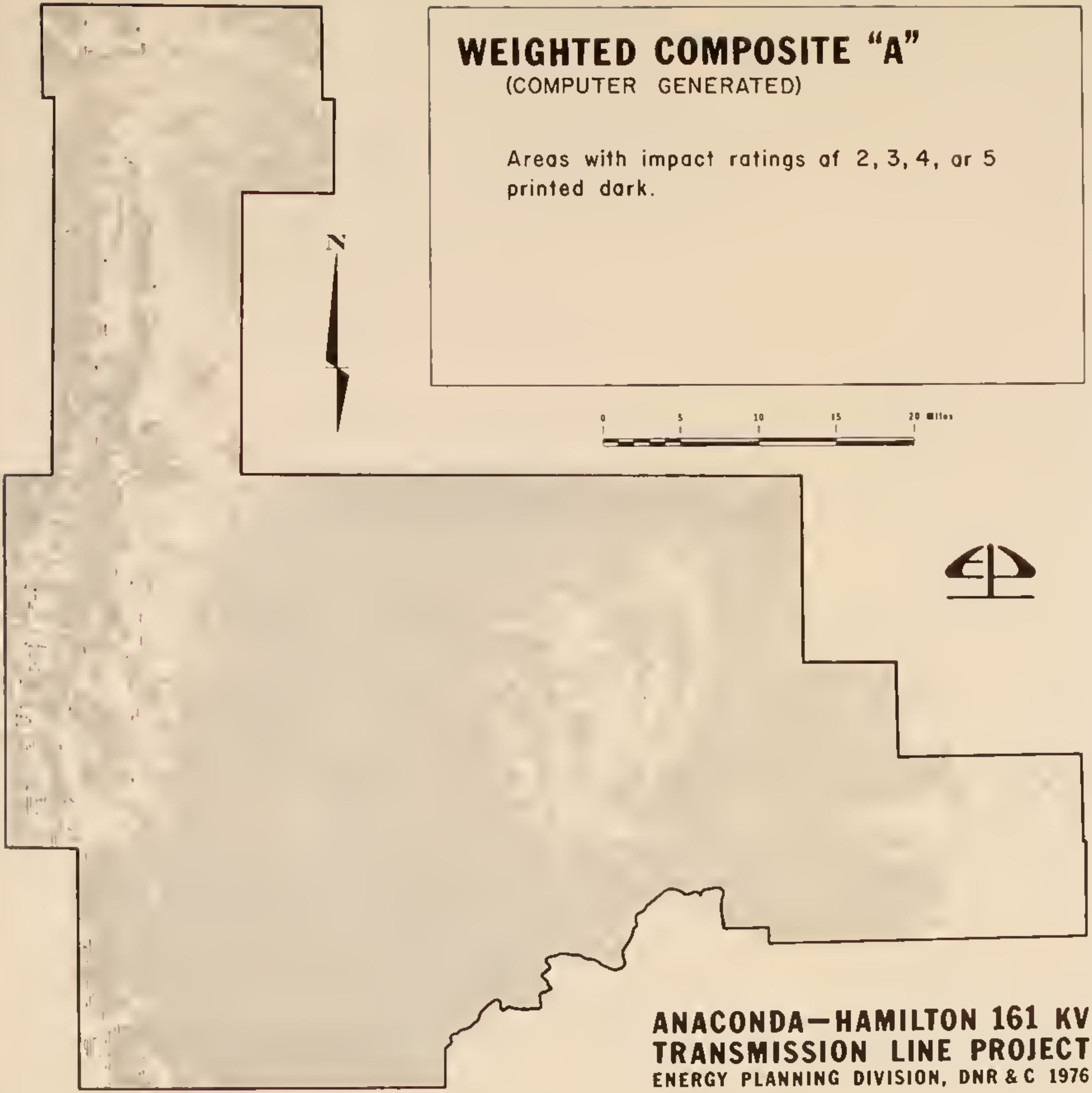
ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

WEIGHTED COMPOSITE "A"

(COMPUTER GENERATED)

Areas with impact ratings of 2, 3, 4, or 5 printed dark.



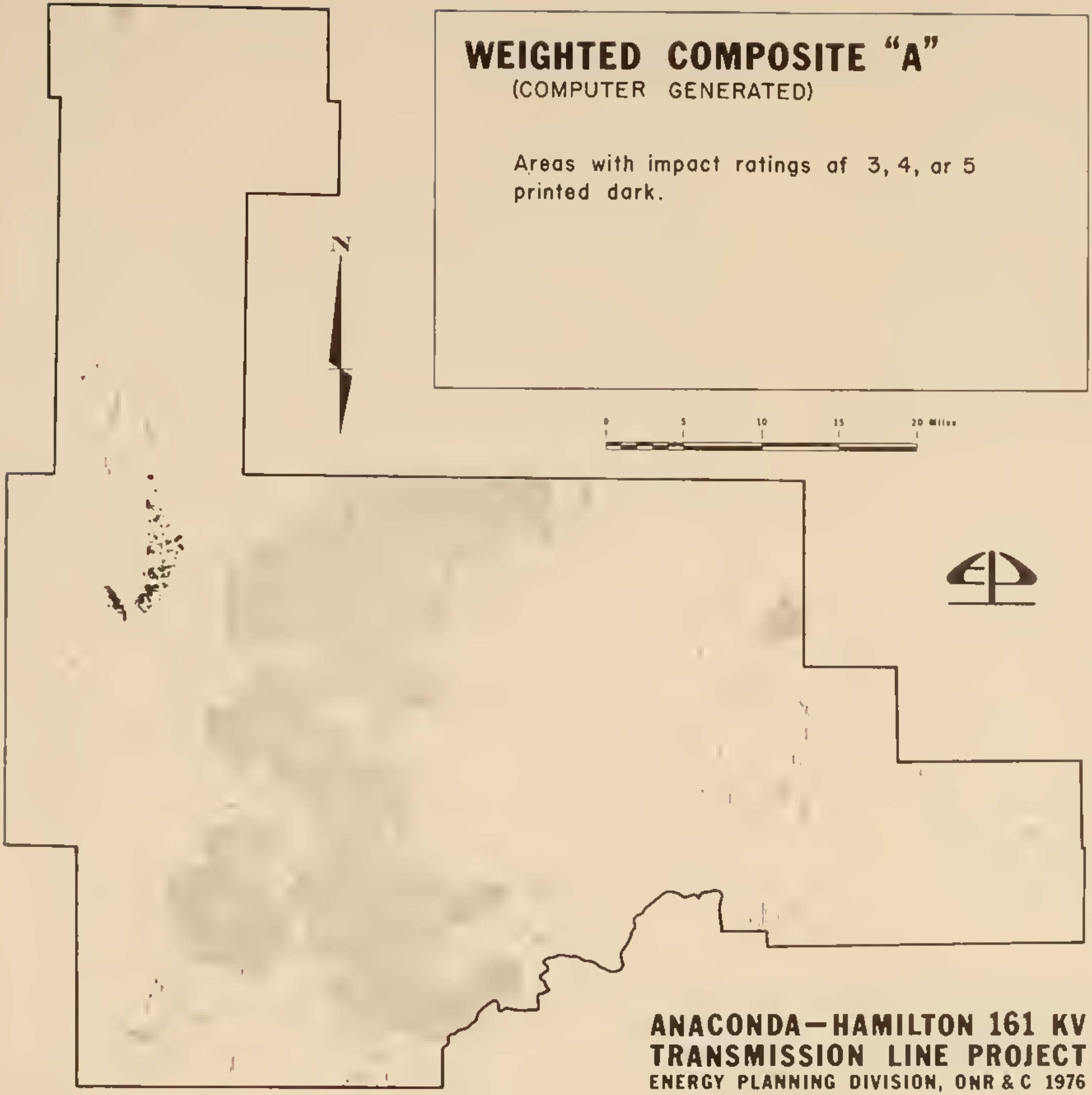
ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

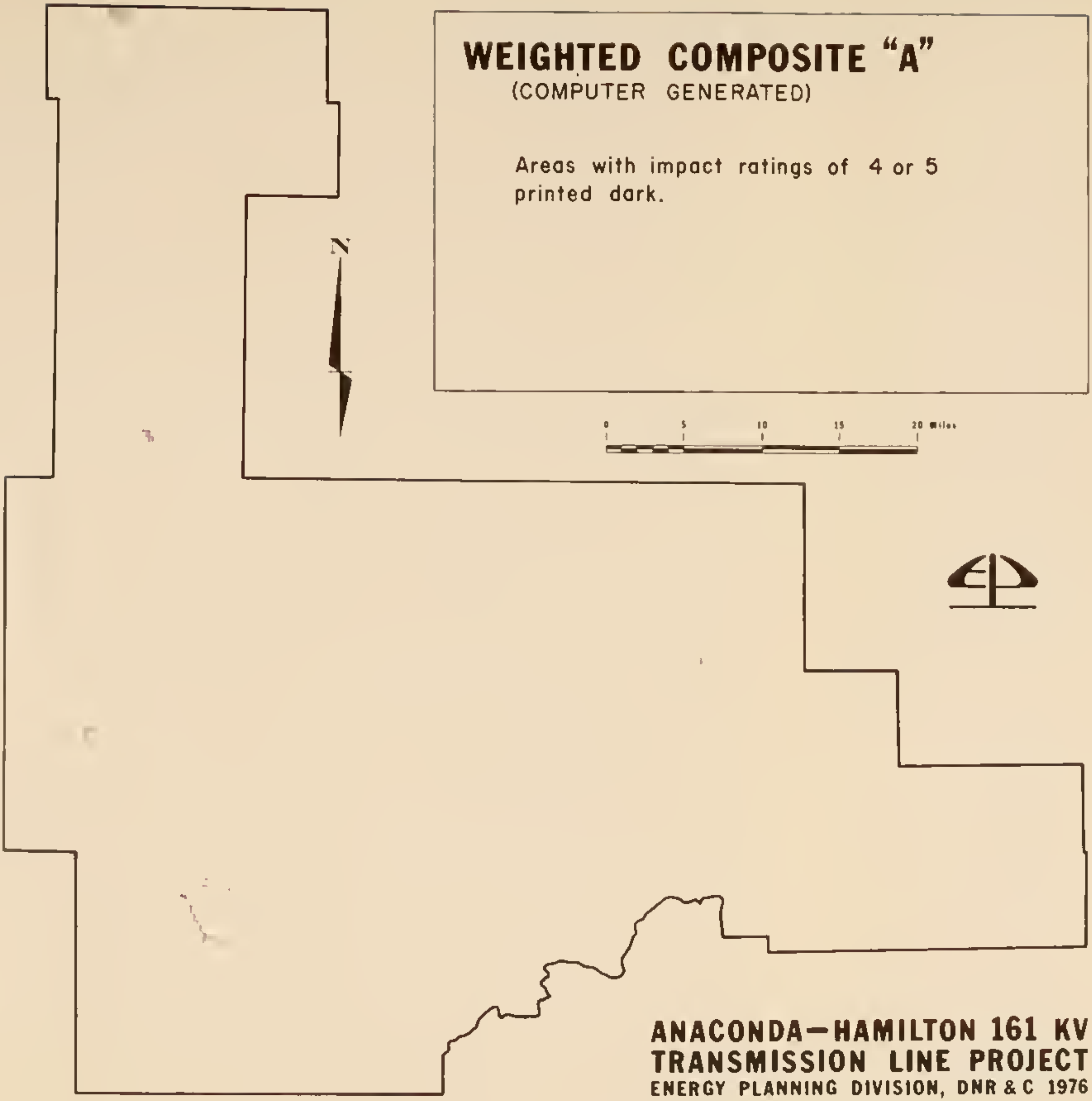
WEIGHTED COMPOSITE “A”

(COMPUTER GENERATED)

Areas with impact ratings of 3, 4, or 5 printed dark.



ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, ONR & C 1976



WEIGHTED COMPOSITE "A"

(COMPUTER GENERATED)

Areas with impact ratings of 4 or 5 printed dark.

ANACONDA—HAMILTON 161 KV
TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976

area is not compatible with future wilderness disignation of the area included in S.B. 393. The amount of cropland and settled area affected by this corridor is insignificant.

E. Impacts on Terrestrial Fauna. Since much of this corridor crosses roadless, forested land, the potential for habitat alteration and disturbance to wildlife due to timber clearing and road construction is relatively great. Several areas which have been identified as having large to severe impact potential are also included in this corridor. One is segment H-I, which crosses an essentially roadless area of Douglas fir and ponderosa pine forests interspersed with grassy openings, an important wintering area for mule deer and elk. Another is sedment G-F, which traverses the high, moist subalpine fir forests at the head of Railroad Creek. This is a roadless area and provides important summer-fall habitat and security areas for elk, mule deer, and moose. A third area of concern is segment E-D, which includes winter habitat of moose and elk near the Middle and East Forks of Rock Creek.

F. Social/Economic Impacts. Potential impacts of the proposed line on the economy and social structure are relatively small in magnitude, often intangible, and largely independent of corridor location. However, some differences can be expected between a Bonner-Hamilton route and an Anaconda-Hamilton route. All routes from Anaconda-Hamilton, including the applicant's preferred route, are expected to result in some detrimental social impacts. Some people will be opposed to construction of a line through the high country of the Sapphire Divide, and others will oppose the line on the basis of fears of subsequent similar development of the Magruder Corridor. Economically depressed areas, such as Deer Lodge and Granite Counties, may benefit somewhat from the additional tax return.

G. Summary of Potential Adverse Impacts, MPC Preferred Route.

Impacts to Aquatic Ecosystems: slight to moderate along most of corridor; large to severe in vicinity of Sand Basin, Sapphire Divide, and along Skalkaho and Daly Creeks.

Impacts to Land Productivity: slight for rangeland and agricultural land; large for forest productivity, as the corridor traverses an area of almost continuous forest.

Visual Impacts: large to severe over most of length; greatest in roadless areas adjacent to Sapphire Divide.

Impacts to Land Use Patterns: potential for severe impact to non-selected roadless areas and citizen-proposed wilderness study areas along Sapphire Divide.

Impacts to Terrestrial Fauna: large to severe potential for adverse impact where corridor crosses roadless areas along the Sapphire Divide and winter ranges in foothills of Sapphire and Anaconda Mountains.

Socio/Economic Impacts: potential for adverse impacts to those opposed to a line across the Sapphire Mountains; nuisance impacts.

7.3.1.2. MPC Alternative Corridors

A number of alternative corridors have been identified by MPC and are shown on the overlays. North of the MPC preferred corridor, one alternative extends from Point J near the proposed Hamilton Heights substation site, across Skalkaho Pass, and to point E near Moose Meadows. Another connects points A and C north of Highway 10A, crossing the foothills of the Flint Creek Range. South of the MPC preferred corridor, one alternative extends south of the Anaconda substation site to Sleeping Child Creek, follows the Sleeping Child Canyon and Martin Creek to Moose Creek, crosses the Sapphire Divide at Frogpond Basin, continues down the canyon of Copper Creek to Moose Lake, then joins the MPC prefereed corridor at point D. Other alternatives include segments L-H along Skalkaho Creek, M-G and F-N through the high Sapphire Mountains, E-O along the foothills of the Anaconda range south of East Fork Reservoir, and A-B which approaches the Anaconda substation south of Mill Creek.

A. Impacts to Aquatic Ecosystems. The applicants' southern alternative corridors (map points L-M-O, M-N-F) include a large area that has been identified as having a large to severe risk for aquatic ecosystem impacts. Most of the area has been given a severe erodibility hazard rating by the USFS and is subject to the same limitation previously discussed for areas of this rating. These alternative corridors parallel headwater drainages of several important streams including the West Fork of Rock Creek, Sleeping Child Creek, and Moose Creek, an important tributary of the East Fork of the Bitterroot River. These areas contain populations of native salmonid fish species, with spawning and rearing sites located throughout the drainages. The risk for impact to these streams by a corridor paralleling their drainages is high, due to the severe erodibility hazard characteristic of the area. Impact risk along the northern alternative corridor (E-I) is slight to moderate, with the exception of the Sand Basin area along segment P-E, which is an area of large to very large impact risk.

B. Impacts to Land Productivity. The MPC alterntive corridors, like the MPC preferred corridor, cross a good deal of forested land; potential impact to forest productivity is high to severe throughout most. Alternative J-L-M-O has a particularly high risk for impact to forest productivity, simply because of its excessive length through forested land. None of the alternatives cross significant amounts of cropland, and potential for impact to rangeland is not significant within the alternative corridors.

C. Visual Impact. Potential for adverse visual impact is large to severe along most of the length of all MPC alternative corridors, with the exceptions of segments J-L, A-C, and A-B. The remainder of the corridors cross closed-canopy coniferous forests, areas where a cleared right-of-way would be highly visible. Areas of highest potential for visual impact are the roadless areas of the Sapphire Mountains; these are crossed by segments L-M, I-S-R-P, N-F, and M-O. Also of especially high visual impact potential are the Moose Lake area and the recreation sites of upper Sleeping Child Creek, which are included within segments M-O and L-M, respectively.

D. Impacts on Land Use Patterns. All MPC alternatives which cross the Sapphire Mountains include some roadless land, as identified on the Recreation map. Roadless land is included in segments I-S-R-P-E, L-H-G-N-F-E, and L-M-O; segments P-E, N-F-E, and M-O include areas proposed for wilderness study under S.B. 393, and hence have the potential for severe impact to future recreational land use. The amount of cropland or settlement areas included in all alternatives, is small.

E. Impacts on Terrestrial Fauna. All alternative corridors through the Sapphires, like the MPC preferred corridor, include much forested, roadless land, mostly subalpine fir forests, and have high potential for disturbance to wildlife and alteration of habitat. These alternatives cross areas of moderate to severe wildlife impact potential, as identified in the Wildlife Composite map. Segments J-L, L-H, L-M, I-S, and E-O include important winter ranges used by elk, deer, and moose. High, moist drainage heads, which are important summer-fall elk habitat, are included in all segments which cross the Sapphire Divide. M-O includes much mountain goat habitat, particularly in the Moose Creek-Fish Lake-Copper Creek area; M-O also includes areas used by bighorn sheep, as does segment A-C. An osprey nest has been located within segment M-O near Moose Lake. Logged areas, which are generally areas of lower impact potential, are included in segment R-P and near point M.

F. Social-Economic Impacts. The impacts of an Anaconda-Hamilton line upon this concern are essentially the same as those of the MPC preferred route.

G. Summary of Potential Adverse Impacts, MPC Alternative Corridors.

Impacts to Auatic Ecosystems: high to severe where southern alternatives cross headwater drainages near the Sapphire Divide and in the Sand Basin area.

Impacts to Land Productivity: slight for rangeland and cultivated land; large for forest productivity, especially within the southern-most alternatives, which are much longer than other alternatives.

Visual Impacts: large to severe along segments crossing the Sapphire Mountains; greatest in roadless areas within the Sapphires.

Impacts to Land Use Patterns: potential for severe impact to non-selected roadless areas and citizen-proposed wilderness study areas along Sapphire Divide.

Impacts to Terrestrial Fauna: large to severe potential for adverse impact where winter ranges are crossed in foothills of Sapphire, Anaconda, and Flint Creek Ranges, and within roadless areas along the Sapphire Divide.

Socio/Economic Impacts. potential for adverse impact to those opposed to a line across the Sapphire Mountains; also nuisance impacts.

7.3.1.3. EPD Alternative Corridors

The alternative corridors identified by EPD are shown on the overlays. Three alternatives are given from Hamilton Heights to Skalkaho Pass. These include a northern alternative along Willow Creek and over Palisade Mountain; a central alternative connecting points K and Q in essentially a straight line; and a southern alternative, following the MPC preferred route between points K and T and continuing along Daly Creek to Skalkaho Pass. East of Skalkaho Pass, this corridor continues to the West Fork Rock Creek Road, follows upper Rock Creek Valley to a point several miles north of East Fork Reservoir, continues to Silver Lake, and follows Warm Springs Creek Canyon to Anaconda.

A. Impacts to Aquatic Ecosystems. Most of this corridor crosses areas of slight to moderate impact potential; however, some areas of large impact risk are included. these are areas where the corridor parallels streams having significant salmonid fish populations and containing important spawning and rearing sites, namely Daly Creek (segment Q-T), the East and West Forks of Rock Creek (segment P-C), and Warm Springs Creek (segment A-C). The risk for adverse impact is particularly great where the corridor parallels Daly Creek. Here, steep slopes along the narrow canyon limit options for line placement and increase the risk for direct impact from construction and access-related activities adjacent to the stream. A similar situation is present along the West Fork of Rock Creek, although limitations in line placement appear to be less restrictive. Segments S-Q and R-Q cross high headwater areas of relatively great impact risk.

B. Impacts on Land Productivity. The EPD alternate corridors cross a considerable amount of forested land between Hamilton Heights and the Rock Creek Valley. Segments Q-S-K and Q-R-K would have less impact on forest productivity than segment Q-T-K, which is longer and traverses an area of extremely high productivity along Daly Creek and Skalkaho Creek. East of the Sapphires, the corridor traverses rangeland rather than forested land when possible. Like the other Anaconda-Hamilton corridors, the EPD alternatives do not include significant amounts of cultivated land, although small amounts are included along Warm Springs Creek and the East Fork of Rock Creek.

C. Visual Impacts. The EPD alternatives include much land of large visual impact potential where forested land is traversed, particularly in the Sapphire Mountains. Roadless areas of severe impact potential are included in segments Q-S-K, and Q-R-K; segments Q-P and Q-T skirt the edges of several roadless areas. Potential for visual impact is also very high near Georgetown Lake and the upper Warm Springs Creek Canyon.

D. Impacts on Land Use Patterns. Alternate segments Q-S-K and Q-R-K cross non-selected roadless areas over much of their length; however, none of the DNR alternatives cross areas proposed for future wilderness study under S.B. 393. Segment T-Q-P, along the Saklakho Highway, includes a transportation corridor which has already been established among the remaining roadless areas along the Sapphire Divide. Small amounts of irrigated land are included within the DNR corridor where it crosses the upper Philipsburg Valley and along the Warm Springs Creek valley, and some settled areas are included within this corridor near Anaconda.

E. Impacts on Terrestrial Fauna. The EPD alternative corridors cross areas of slight to moderate wildlife impact potential over most of their length. However, a considerable amount of forested land is included, and several areas of large to severe impact potential are crossed. Segments Q-S-K and Q-R-K cross winter ranges used by elk, moose, and deer along the west slope of the Sapphires, as well as high forested roadless areas used as summer range by elk, moose, and deer and yearlong range for mountain goats. While segment Q-T includes areas used heavily by moose along Daly Creek, it is paralleled by an existing road. Segment C-P, which crosses the Rock Creek and Philipsburg Valleys, includes much deer and elk winter range, as well as willow bottoms used heavily by moose. However, much of this segment, as well as segment A-C, parallels existing roads, and distrubance to wildlife can be greatly reduced by centerline location near these roads.

F. Socio/Economic Impacts. The potential impacts of the EPD corridors upon this concern are essentially the same as those of the MPC preferred route.

G. Summary of Potential Averse Impacts, EPD Alternative Corridors.

Impacts to Aquatic Ecosystems: high to severe in the vicinity of Daly Creek, Skalkaho Creek, and East and West Forks of Rock Creek, and Warm Springs Creek.

Impacts to Land Productivity: slight for rangeland and agricultural land; relatively large for forest productivity, especially along Daly Creek.

Visual Impacts: large to severe where Sapphire Mountains are crossed; greatest in roadless areas within the Sapphires.

Impact to Land Use Patterns: high potential for impact to non-selected roadless areas in Sapphire Mountains; some potential for impact to irrigated cropland and settled areas in the vicinity of Anaconda.

Impacts to Terrestrial Fauna: large to severe potential for adverse impact along winter ranges in the foothills of the Sapphire Mountains, and in the high subalpine roadless areas near Skalkaho Pass.

Socio/Economic Impacts: potential for adverse impact to those opposed to a line across the Sapphire Mountains; also, nuisance impacts.

7.3.2. Alternatives Connecting Bonner and Hamilton

7.3.2.1. EPD Western Alternative

This corridor begins at the Anaconda-Hot Springs 230 kV line near Bonner, follows Deer Creek and Pattee Creek to the Missoula area, continues to the Miller Creek (number 4) substation, and follows Highway 93 southward. An existing 69 kV transmission line is located within this corridor over its entire length.

A. Impacts to Aquatic Ecosystems. This corridor is located entirely within areas having slight to moderate potential for adverse impact to aquatic ecosystems. The areas of greatest potential for impact to fish populations are the Bitterroot River itself and the several important tributaries of the Bitterroot which have their confluence here. The lower portions of these streams are used by both resident and river fish populations for spawning.

B. Impacts on Land Productivity. Between point U and Hamilton, this cordor alternates among highly productive forest land and cultivated land over most of its length. Impact potential for forest productivity and agricultural productivity is high throughout this segment.

C. Visual Impacts. Nearly the entire corridor traverses areas having slight to moderate potential for adverse visual impact. The corridor now includes a major highway, a transmission line, and several telephone lines and distribution lines; a new 161 kV line would not greatly alter the existing visual character of the area. A small area of high impact potential is included in the Deer Creek-Pattee Creek area, where some forested land would be crossed; four small areas of very high impact potential (recreation sites) are found along Highway 93.

D. Impacts on Land Use Patterns. From the Miller Creek substation to Hamilton, this corridor is located completely within a zone of high to severe impact potential, which includes irrigated land, dry cropland, bottom land mix, settlement areas, historic sites, campgrounds, and a national wildlife refuge. The corridor north of Miller Creek has less potential for adverse impact to land use patterns, but includes a recreation area along Pattee Creek.

E. Impacts on Terrestrial Fauna. With the exception of a small area of forested land adjacent to Deer Creek and Pattee Creek, and the Ravalli National Wildlife Refuge, this corridor traverses an area of slight to moderate wildlife impact potential. Some waterfowl losses are expected to occur as a result of line placement adjacent to the Bitterroot River, especially near the Ravalli National Wildlife refuge. Timber clearing and other construction activities in riparian forests may remove some cover for animals using these forests, and could be disruptive to nesting osprey and great blue herons along the Bitterroot River.

F. Socio/Economic Impacts. Some detrimental social impacts are expected regardless of the location of a transmission line in the Bitterroot Valley.

Undoubtedly, some people will be opposed to construction of a line in the wilderness-like areas between Anaconda and Hamilton, but opposition is expected to be greater in the Bitterroot Valley. Intense development of the Valley has created a cluttered utility corridor, and residents have shown by past legal actions that they are against any further such development. Both routes are expected to be opposed on the basis of fears of subsequent similar development of the Magruder Corridor. Economic impacts are expected to be insignificant.

G. Summary of Potential Impacts, EPD Western Corridor.

Impacts to Aquatic Ecosystems: insignificant to moderate throughout.

Impacts on Land Productivity: high potential for impact to both forest and agricultural productivity.

Visual Impacts: insignificant to moderate, except in the vicinity of recreation sites and in the Pattee Canyon-Deer Creek area, where potential exists for high to very high impact.

Impacts on Land Use Patterns: high to severe for most of length through Bitterroot Valley.

Terrestrial Fauna: insignificant to moderate except in Pattee Canyon-Deer Creek area and in vicinity of Ravalli National Wildlife refuge.

Socio/Economic Impacts: potential for intense opposition to a new transmission line; nuisance impacts.

7.3.2.2. EPD Eastern Alternative

From Bonner to the Miller Creek substation, this corridor is identical to that discussed above (the EPD western alternative); hence, the discussion which follows will be limited to the corridor south of Miller Creek. From the Miller Creek substation to Hamilton Heights, this corridor follows the existing MPC 161 kV line along the eastern edge of the Bitterroot Valley, as shown on the overlay.

A. Impacts to Aquatic Ecosystems: With the exception of the Burnt Fork of the Bitterroot River, this corridor is entirely within areas identified as having insignificant to slight potential for adverse impact to aquatic ecosystems. The Burnt Fork supports a productive sport fishery along the section crossed by this corridor, and careful location of tower sites with a minimum of construction or access-related disturbances would be necessary to reduce the impact risk in this area. Along the remainder of the corridor, utilization of roads available for access to the existing 161 kV transmission line would further reduce the impact risks.

B. Visual Impacts: Small areas of large visual impact potential are included where the corridor crosses timbered areas in the foothills of the Sapphires, but most of the corridor includes areas of slight to moderate impact potential. This corridor contains an existing 161 kV line, and the addition of a second line within the same right-of-way would not greatly alter the visual character of the area.

C. Impacts to Land Productivity. The EPD eastern corridor includes very little forested land or cultivated land. This corridor is situated mainly in rangeland,where productivity losses are expected to be less than in forested or cultivated land.

D. Impacts to Land Use Patterns. This corridor generally circumvents the irrigated land, dry cropland, and settlement areas located farther west in the Bitterroot Valley. Impact upon existing land use patterns is expected to be minor.

E. Impacts to Terrestrial Fauna. Most of this corridor crosses areas of insignificant to moderate wildlife impact potential. However, the corridor is located in the lower foothills of the Sapphire Mountains, and in some areas pockets of timber interspersed with grassland are found which are used by wintering elk and deer. Impact potential in these areas is large to severe, but potential impacts can be mitigated or prevented by closely paralleling the existing 161 kV line, using existing access roads, and limiting construction to the summer and fall months.

F. Socio/Economic Impacts. These impacts are not expected to differ from those of the EPD western corridor.

G. Summary of Potential Impacts, EPD Eastern Corridor.

Impacts to Aquatic Ecosystems: no significant impacts expected.

Impacts to Land Productivity: no significant impacts expected.

Visual Impacts: no significant impacts expected.

Impacts to Land Use Patterns: no significant impacts expected.

Impacts to Terrestrial Fauna: no significant impacts expected.

Socio/Economic Impacts: some opposition to the line is expected; nuisance impacts.

7.3.3. Comparison of Alternative Corridors

7.3.3.1. Impact to Aquatic Ecosystems

Existing access roads and the crossing of a minimum number of important tributary streams identify the EPD alternative along the east side of the Bitterroot Valley as the corridor having the least potential for adverse impact to the aquatic ecosystems. The corridors across the Sapphire Mountains cross numerous productive streams and/or their headwater regions, areas having high risk for increased sedimentation and for adversely affecting the aquatic ecosystems. Of these alternatives crossing the Sapphires, the EPD route K-S-Q-A includes fewest areas of large or severe impact risk; the MPC alternative to the south (A-O-M-L-J) includes the most, partly due to its relatively great length.

7.3.3.2. Impacts to Land Productivity

Table 7-2 summarizes the number of miles of land in the higher productivity categories for the major alternative corridors. It is clear from this table that the EPD eastern corridor from Bonner to Hamilton has least potential for adverse impact on land productiviity, and at the same time is ten miles shorter than the shortest Anaconda-Hamilton corridors. Of the corridors connecting Anaconda and Hamilton, the EPD corridor A-C-P-Q-S-K has the least potential for impact to land productivity.

7.3.3.3. Visual Impact

The corridor representing the least potential for visual impact is the EPD eastern corridor from Bonner to Hamilton, which follows an existing 161 kV transmission line. Visual impact potential for the western corridor is somewhat greater. All corridors crossing the Sapphires have a much higher potential for visual impact, especially those crossing roadless areas.

7.3.3.4. Impacts on Land Use Patterns

The EPD eastern corridor from Bonner to Hamilton has the lowest potential for adverse impact to existing land use site patterns of all alternatives. The western EPD corridor could potentially interfere with much cropland and residential land uses, and nearly all alternatives crossing the Sapphire Divide cross roadless land or areas proposed for wilderness study under Senate Bill 393.

7.3.3.5. Impacts to Terrestrial Fauna

Both EPD corridors from Bonner to Hamilton have little potential for adverse impact to wildlife, as they include existing utility corridors, transportation corridors, and/or access roads. In contrast, wildlife impact potential is much greater for corridors crossing the Sapphires, as these include winter ranges, much forested land, and large roadless areas. Of the corridors connecting Anaconda and Hamilton, the EPD alternative T-Q-A (including MPC alternative K-J-L-H-T) presents least potential for adverse impact, as it follows existing roads and/or logged areas for most of its length.

7.3.3.6. Socio/Economic Impacts

Opposition to a Bitterroot Valley line is expected to be greater than that to a line across the Sapphires, although both possibilities could result in organized opposition. Economic impacts are expected to be minimal regardless of the route taken by the line.

TABLE 7-2

COMPARISON OF ALTERNATIVE CORRIDORS
(Figures are approximations based on a two-mile-wide corridor)

	MPC Preferred	MPC Alternative A-C-D-E-R-S-I-J-K	MPC Alternative A-B-C-D-O-M-L-J-K	DNR Alternative A-C-P-W-S-K	DNR Alternative V-U-K (west)	DNR Alternative V-U-K (east)
LENGTH (miles)	65	66	84	62	50	51
Corridor Elevation (Relief)						
Percent of total length <4000' in elevation	0	0	*	0	89	36
Percent of total length between 4000' and 6000'	30	35	34	39	11	64
Percent of total length between 6000' and 8000'	70	64	66	62	0	0
Percent of total length >8000'	0	1	*	*	0	0
Forest Productivity						
<50 cu.ft./acre/yr. (miles)	4.7	10.6	9.5	7.9	1.0	4.3
50-80 cu.ft./acre/yr. (miles)	36.1	29.8	34.8	15.8	4.0	4.3

TABLE 7-2 (continued)

	MPC Preferred	MPC Alternative A-C-D-E R-S-I- J-K	MPC Alternative A-B-C-D- O-M-L- J-K	DNR Alternative A-C-P- W-S-K	DNR Alternative V-U-K (west)	DNR Alternative V-U-K (east)
80-110 cu.ft./acre/yr. (miles)	4.7	4.9	10.7	6.3	*	*
>110 cu.ft./acre/yr. (miles)	0.8	0	7.9	0	10.3	0
Irrigated Land (sq. mi.)	0	0	0.5	1	12	3.5
Dry Cropland (sq. mi.)	0	0	0	0	1	9
Bottomland Mix (sq. mi.)	0.5	1	0	2.5	21	1
Scattered Built-up Areas (incl. subdivisions) (sq. mi.)	*	0.5	*	3	13	7
Small Communities (sq. mi.)	0	0	0	0	*	0
Urban and Industrial (sq. mi.)	3	6	1	7	1	*
Roadless Land						
U.S.S.B. 393 (sq. mi.)	12	5	5	0	0	0
USFS New Study Area (sq. mi.)	0	0	0	0	0	0
Non-selected Roadless Area (sq. mi.)	7	18	23	16	0	0

TABLE 7-2 (continued)

	MPC Prefereed	MPC Alternative A-C-D-E-R-S-I-J-K	MPC Alternative A-B-C-D-O-M-L-J-K	DNR Alternative A-C-P-W-S-K	DNR Alternative V-U-K (west)	DNR Alternative V-U-K (east)
Recreational and Historic Sites	4	3	6	5	11	1
Impact Risk Categories, Aquatic Ecosystems						
0 (None or insignificant), square miles	10	19	6	25	53	5
1 (Significant but slight), square miles	58	45	57	47	21	84
2 (Moderate), square miles	20	28	29	22	10	1
3 (Large), square miles	14	6	33	3	*	1
4 (Severe), square miles	*	*	5	*	0	*
Impact Risk Categories, Terrestrial Fauna						
0 (None or insignificant), square miles	9	12	12	32	31	20
1 (Significant but slight), square miles	11	7.5	21	13.5	30	24

TABLE 7-2 (continued)

	MPC Preferred	MPC Alternative A-C-D-E-R-S-I-J-K	MPC Alternative A-B-C-D-O-M-L-J-K	DNR Alternative A-C-P-W-S-K	DNR Alternative V-U-K (west)	DNR Alternative V-U-K (east)
2 (Moderate), square miles	55	48	70	35	7.5	18
3 (Large), square miles	25	26	19	15.5	1	7
4 (Severe), square miles	2.5	0.5	3	*	0	*
Impact Risk Categories, Visual						
0 (None or insignificant), square miles	6	10	3	14	12	2
1 (Significant but slight), square miles	1	4	2	10	40	46
2 (Moderate), square miles	26	30	39	25	20	25
3 (Large), square miles	69	57	70	36	7	10
4 (Severe), square miles	8	20	26	19	4	0

* less than 0.5

7.4. Short-Term and Long-Term Effects on Productivity

If a need for an additional transmission line is established in the Hamilton area, immediate benefits would include increased system reliability. Long-term commitments of land are important. For example, some cropland, rangeland, or forested land may be taken out of production to accomodate access roads and the right-of-way. This initial loss of productive land may represent the beginning of a cumulative effect as development continues to remove productive land from agricultural or forestry uses.

The effects of transmission lines on aesthetics are both immediate and long-term. While persons may eventually become accustomed to the line's visual presence, their perception of the landscape will nevertheless be influenced because the line will detract from the landscape's scenic quality.

Most of all, however, the proposed Anaconda-Hamilton 161 kV line represents a long-term commitment of land. It will probably exist as long as a need for electrical energy exists in the Hamilton area, and as long as technology can supply energy to meet this need. The possible effects of increased power availability on future growth patterns in the Bitterroot Valley, while difficult to predict, deserve mention. The cause-and-effect relationship between growth and power availability is complex; growth demands increased power availability. In constructing the proposed line and supplying projected future power needs, a commitment is made to allow increased population density, increased use of energy, and continued land use change in the Valley. All of these have significant long-term effects on the total environment of the Valley.

7.5. Irreversible and Irretrievable Effects

In theory, with the exception of the consumption of energy, most of the resources directly involved in the transmission line construction are retrievable. In reality, however, only those of most value, primarily conductors, are usually reclaimed if the line is removed or reconstructed. Thus the balance of the remaining material (e.g., poles, insulators, shipping crates) can be considered irretrievably commited. The ultimate retrievability of these items, however, may be subject to future re-use and recycling policies.

When a transmission line crosses productive agricultural land, a certain amount of the land productivity may be irretrievably commited for the life of the line or possibly beyond. This can occur if factors attributable to the transmission line prevent a future increase in or continuance of present levels of productivity. Direct loss of agricultural land may occur because poles or their support structures occupy the area. The physical presence of the line may place restrictions on certain agricultural practices (overhead irrigation, for example), especially where the practice is essential to maintain the productivity of an area. Likewise, if right-of-way clearance involves the removal of trees from an area of existing or future production of marketable timber, as well as the continued control of tree growth along the corridor, a certain amount of potential productivity can be considered irretrievably committed.

To the extent that a transmission line can potentially influence future land use in adjacent areas, a less definable commitment of resources is also associated with the line. Although a particular resource may not be considered entirely irretrievably or irreversably commited to the line, there is little doubt that certain qualities or values attributable to the resource can be altered or lost subsequent to construction of the line. The values of a visual resource, for example, may be lost if the construction or physical presence of the line should set in motion processes (either natural or cultural) that would form a permanent visual impact.

Another form of commitment is the closing of certain options for use of an area. In particular the roadless, wilderness-like area along the Saphire Divide could be designated formal wilderness status and these qualities could be preserved. However, a transmission line (or any other development) closes that possibility as an option. Development of a wilderness area is a one-way door and once development has occurred, the wilderness qualities are lost and cannot be regained within a long period of time.

APPENDIX A

TABLE I
ESTIMATED LOAD DATA
RAVALLI COUNTY ELECTRIC CO-OP

AVERAGE NO. OF CUSTOMERS	1972	1973	1974	1975	1976	1981
Domestic	640	700	760	820	880	1,180
Seasonal Domestic	8	8	8	8	8	8
Commercial	11	12	13	14	15	20
Large Power	1	1	1	1	1	1
Irrigation	200	203	206	209	212	227
Street Lighting						
Public Authorities						
TOTAL	860	924	988	1,052	1,116	1,436
KWH PER CUSTOMER						
Domestic	18,300	19,000	19,700	20,400	21,100	24,600
Seasonal Domestic	2,300	2,400	2,500	2,600	2,700	3,200
Commercial	23,800	24,600	25,400	26,200	27,000	31,000
Irrigation	19,000	19,800	20,600	21,400	22,200	26,200
Street Lighting						
Public Authorities						
ENERGY SALES (MWH)						
Domestic	11,712	13,300	14,972	16,728	18,568	29,028
Seasonal Domestic	18	19	20	21	22	26
Commercial	262	295	330	367	405	620
Large Power	50	50	60	60	70	90
Irrigation	3,800	4,019	4,244	4,473	4,706	5,947
Street Lighting						
Public Authorities						
Utility Use	250	255	260	265	270	295
TOTAL	16,092	17,938	19,886	21,914	24,041	26,006
PERCENT LOSS	10.0	10.0	10.0	10.0	10.0	10.0
Energy Requirements	17,880	19,930	22,100	24,350	26,710	40,010
Annual Load Factor	52.3	52.9	53.1	52.9	52.9	52.9
Annual Peak Demand (KW)	3,900	4,300	4,750	5,250	5,760	8,640
Month of Annual Peak	Jan.	Jan.	Jan.	Jan.	Jan.	Jan.
January Peak (KW)	3,900	4,300	4,750	5,250	5,760	8,640
August Peak (KW)	3,290	3,480	3,710	3,930	4,180	5,780
December Peak(KW)	3,810	4,210	4,660	5,160	5,670	8,550

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, 3/72.

Note: Point of Delivery--Corvallis.

TABLE II
ESTIMATED LOAD DATA
RAVALLI COUNTY ELECTRIC CO-OP

AVERAGE NO. OF CUSTOMERS	1972	1973	1974	1975	1976	1981
Domestic	290	315	340	365	390	515
Seasonal Domestic	145	155	165	175	185	235
Commercial	44	45	46	47	48	53
Large Power	5	5	5	5	5	5
Irrigation	37	40	43	46	49	64
Street Lighting						
Public Authorities	5	5	5	5	5	5
TOTAL	526	565	604	643	682	877
KWH PER CUSTOMER						
Domestic	15,800	16,500	17,200	17,900	18,600	22,100
Seasonal Domestic	1,500	1,600	1,700	1,800	1,900	2,400
Commercial	23,800	24,600	25,400	26,200	27,000	31,000
Irrigation	10,400	10,600	10,800	11,000	11,200	12,200
Street Lighting						
Public Authorities	6,000	6,200	6,400	6,600	6,800	7,800
ENERGY SALES (MWH)						
Domestic	4,582	5,198	5,848	6,534	7,254	11,382
Seasonal Domestic	218	248	281	315	352	564
Commercial	1,047	1,107	1,168	1,231	1,296	1,643
Large Power	8,550	8,750	8,950	9,150	9,350	10,350
Irrigation	385	424	464	506	549	781
Street Lighting						
Public Authorities	30	31	32	33	34	39
TOTAL	14,812	15,758	16,748	17,769	18,835	24,759
PERCENT LOSS	10.0	10.0	10.0	10.0	10.0	10.0
Energy Requirements	16,460	17,510	18,600	19,740	20,930	27,510
Annual Load Factor	41.9	42.0	42.0	42.1	42.2	42.2
Annual Peak Demand (KW)	4,760	4,760	5,050	5,350	5,660	7,450
Month of Annual Peak	Jan.	Jan.	Jan.	Jan.	Jan.	Jan.
January Peak (KW)	4,480	4,760	5,050	5,350	5,660	7,450
August Peak (KW)	3,120	3,280	3,450	3,630	3,820	4,850
December Peak (KW)	4,350	4,630	4,920	5,220	5,530	7,320

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, 3/72.

NOTE: Point of Delivery--Darby

TABLE III
ESTIMATED LOAD DATA
RAVALLI COUNTY ELECTRIC CO-OP

AVERAGE NO. OF CUSTOMERS	1972	1973	1974	1975	1976	1981
Domestic	170	180	190	200	210	260
Seasonal Domestic						
Commercial	3	3	3	3	3	3
Large Power						
Irrigation	80	83	86	89	92	107
Street Lighting						
Public Authorities						
TOTAL	253	266	279	292	305	370
KWH PER CUSTOMER						
Domestic	18,300	19,000	19,700	20,400	21,100	24,600
Seasonal Domestic						
Commercial	21,200	21,700	22,200	22,700	23,200	25,700
Irrigation	19,000	19,800	20,600	21,400	22,200	26,200
Street Lighting						
Public Authorities						
ENERGY SALES (MWH)						
Domestic	3,111	3,420	3,743	4,080	4,431	6,396
Seasonal Domestic						
Commercial	64	65	67	68	70	77
Large Power						
Irrigation	1,520	1,643	1,772	1,905	2,042	2,803
Street Lighting						
Public Authorities						
TOTAL	4,695	5,128	5,582	6,053	6,543	9,276
PERCENT LOSS	10.0	10.0	10.0	10.0	10.0	10.0
Energy Requirements	5,220	5,700	6,200	6,730	7,270	10,310
Annual Load Factor	50.1	50.8	51.7	51.9	52.5	53.3
Annual Peak Demand (KW)	1,190	1,280	1,370	1,480	1,580	2,210
Month of Annual Peak	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.
January Peak (KW)	1,090	1,180	1,280	1,400	1,520	2,140
August Peak (KW)	1,190	1,280	1,370	1,480	1,580	2,210
December Peak (KW)	1,060	1,150	1,260	1,360	1,470	2,080

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, 3/72.

NOTE: Point of Delivery--Grantsdale.

TABLE IV
ESTIMATED LOAD DATA
RAVALLI COUNTY ELECTRIC CO-OP

AVERAGE NO. OF CUSTOMERS	1972	1973	1974	1975	1976	1981
Domestic	320	345	370	395	420	545
Seasonal Domestic						
Commercial						
Large Power						
Irrigation	74	79	84	89	94	119
Street Lighting						
Public Authorities	2	2	2	2	2	2
TOTAL	396	426	456	486	516	666
KWH PER CUSTOMER						
Domestic	19,000	19,700	20,400	21,100	21,800	25,300
Seasonal Domestic						
Commercial						
Irrigation	25,000	25,500	26,000	26,500	27,000	29,500
Street Lighting						
Public Authorities	61,000	62,000	63,000	64,000	65,000	70,000
ENERGY SALES (MWH)						
Domestic	6,080	6,797	7,548	8,335	9,156	13,789
Seasonal Domestic						
Commercial						
Large Power						
Irrigation	1,850	2,015	2,184	2,359	2,538	3,511
Street Lighting						
Public Authorities	122	124	126	128	130	140
TOTAL	8,052	8,936	9,858	10,822	11,824	17,440
PERCENT LOSS	10.0	10.0	10.0	10.0	10.0	10.0
Energy Requirements	8,950	9,930	10,950	12,020	13,140	19,380
Annual Load Factor	51.1	53.2	53.2	53.4	53.4	53.3
Annual Peak Demand (KW)	2,000	2,130	2,350	2,570	2,810	4,150
Month of Annual Peak	Jan.	Jan.	Jan.	Jan.	Jan.	Jan.
January Peak (KW)	2,000	2,130	2,350	2,570	2,810	4,150
August Peak (KW)	1,750	1,890	2,040	2,180	2,340	3,320
December Peak (KW)	1,910	2,040	2,260	2,480	2,720	4,060

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, 3/72.

NOTE: Point of Delivery--Stevensville

TABLE V
ESTIMATED SALES DATA
LARGE POWER CUSTOMERS
RAVALLI COUNTY ELECTRIC CO-OP

PEAK KW

ELIVERY POINT & CUSTOMER	1972	1973	1974	1975	1976	1981
orvallis:						
Pfau Pellet Mill	120	120	130	130	130	150
arby:						
Conner Chipper	320	320	320	320	320	320
Conner Planer	420	420	420	420	420	420
Conner Sawmill	520	540	560	580	600	700
S&W Sawmill	1,040	1,080	1,120	1,160	1,200	1,400
Trapper Co. Job Corps	1,150	1,180	1,210	1,240	1,270	1,420
Total	3,450	3,540	3,630	3,720	3,810	4,260
Grand Total	3,570	3,660	3,760	3,850	3,940	4,410

ENERGY MWH

Corvallis:						
Pfau Pellet Mill	50	50	60	60	70	90
Darby:						
Conner Chipper	600	600	600	600	600	600
Conner Planer	800	800	800	800	800	800
Conner Sawmill	1,050	1,100	1,150	1,200	1,250	1,500
S&W Sawmill	3,300	3,400	3,500	3,600	3,700	4,200
Trapper Co. Job Corps	2,800	2,850	2,900	2,950	3,000	3,250
Total	8,550	8,750	8,950	9,150	9,350	10,350
Grand Total	8,600	8,800	9,010	9,210	9,420	10,440

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, 3/72.

TABLE VI
HISTORICAL SALES DATA
LARGE POWER CUSTOMERS
RAVALLI COUNTY ELECTRIC CO-OP

PEAK KW

DELIVERY POINT & CUSTOMER	1966	1967	1968	1969	1970	1971
Corvallis:						
Bergman Feedlot	64	77	61			
Pfau Pellet Mill	108	113	113	124	96	104
Total	172	190	174	124	96	104
Darby:						
S&W Sawmill	578	633	988	1,153	948	1,008
S&W Studmill	314	373	404	352		
Conner Sawmill	542	623	592	602	512	504
Conner Planer	292	311	456	477	392	416
Conner Chipper	289	342	384	384	320	320
Trapper Co. Job Corps	924	1,015	1,204	1,447	990	1,116
Total	2,939	3,297	4,028	4,415	3,162	3,364
Grand Total	3,111	3,487	4,202	4,539	3,258	3,468

ENERGY MWH

DELIVERY POINT & CUSTOMER	1966	1967	1968	1969	1970	1971
Corvallis:						
Bergman Feedlot	23	26	4			
Pfau Pellet Mill	28	33	25	28	47	45
Total	51	59	29	28	47	45
Darby:						
S&W Sawmill	1,658	1,793	1,730	2,859	2,819	3,215
S&W Studmill	646	806	739	31		
Conner Sawmill	1,316	1,130	1,176	1,329	826	1,025
Conner Planer	368	357	629	789	673	780
Conner Chipper	483	536	654	706	555	470
Trapper Co. Job Corps	2,062	2,242	2,474	2,621	2,768	2,697
Total	6,533	6,864	7,402	8,335	7,641	8,187
Grand Total	6,584	6,923	7,431	8,363	7,688	8,232

SOURCE: U.S. Department of the Interior, Bonneville Power Administration, 3/72.

TABLE VII

LOAD ESTIMATE DATE 3/72
RAVALLI COUNTY ELECTRIC CO-OP

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1975-76	Peak MW	2.8	2.8	2.8	2.8	3.2	4.0	4.5	3.9	4.1	3.3	3.1	2.9	3.3	
	Average MW	2.3	2.3	2.3	1.9	2.3	2.4	2.8	2.5	2.0	1.8	1.7	2.4	2.2	
1976-77	Peak MW	3.0	3.0	3.0	3.0	3.7	4.4	4.6	4.3	4.4	3.5	3.4	3.1	3.6	3.5
	Average MW	2.6	2.6	2.5	2.0	2.6	2.7	3.0	2.7	2.2	2.0	1.9	2.6	2.4	2.3
1977-78	Peak MW	3.2	3.2	3.3	3.3	4.1	4.8	5.1	4.8	5.0	3.7	3.6	3.3	3.9	3.3
	Average MW	2.7	2.7	2.6	2.2	2.9	2.9	3.3	3.0	2.4	2.2	2.1	2.8	2.6	2.5
1978-79	Peak MW	3.5	3.4	3.4	3.5	4.5	5.3	5.5	5.2	5.5	4.0	3.9	3.7	4.3	4.1
	Average MW	2.9	2.9	2.9	2.5	3.1	3.2	3.6	3.3	2.6	2.3	2.2	3.0	2.9	2.8
1979-80	Peak MW	3.7	3.6	3.8	3.9	5.0	5.7	6.1	5.8	6.0	4.5	4.4	4.1	4.7	4.5
	Average MW	3.2	3.2	3.1	2.7	3.5	3.5	3.9	3.6	2.9	2.5	2.4	3.3	3.0	3.0
1980-81	Peak MW	4.0	4.0	4.0	4.3	5.5	6.2	6.6	6.2	6.5	4.9	4.9	4.5	5.1	4.9
	Average MW	3.4	3.4	3.3	2.9	3.8	3.8	4.2	3.9	3.1	2.8	2.6	3.5	3.4	3.3
1981-82	Peak MW	4.3	4.1	4.4	4.6	5.9	6.6	7.0	6.7	7.0	5.3	5.2	4.8	5.5	5.3
	Average MW	3.6	3.6	3.6	3.2	4.0	4.1	4.5	5.2	3.3	3.0	2.9	3.7	3.6	3.5
1982-83	Peak MW	4.6	4.4	4.6	4.9	6.3	7.0	7.6	7.2	7.5	5.8	5.6	5.2	5.9	5.7
	Average MW	3.9	3.9	3.8	3.4	4.4	4.4	4.8	4.5	3.6	3.2	3.0	4.0	3.9	3.8
1983-84	Peak MW	5.0	4.7	5.0	5.3	6.9	7.7	8.2	7.7	8.0	6.2	6.1	5.6	6.4	6.1
	Average MW	4.1	4.1	4.1	3.6	4.7	4.7	5.2	4.8	3.9	3.5	3.3	4.3	4.2	4.0
1984-85	Peak MW	5.4	5.1	5.4	5.6	7.3	8.2	8.8	8.3	8.7	6.6	6.6	6.0	6.8	6.6
	Average MW	4.4	4.4	4.4	3.9	4.9	5.0	5.8	5.0	4.1	3.7	3.6	4.6	4.5	4.3
1985-86	Peak MW	5.8	5.5	5.8	6.0	7.8	8.8	9.4	8.9	9.3	7.1	7.1	6.4	7.3	7.1
	Average MW	4.7	4.7	4.7	4.2	5.2	5.4	6.2	5.5	4.4	4.0	3.9	4.9	4.8	4.6

TABLE VII, Continued

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1986-87 Peak MW	6.2	5.9	6.2	6.4	8.4	9.4	10.1	9.5	10.0	7.6	7.6	6.9	7.8	
Average MW	5.0	5.0	5.0	4.5	5.6	5.8	6.6	5.9	4.7	4.3	4.2	5.3	5.2	
1987-88 Peak MW	6.7	6.3	6.7	6.9	9.0	10.1	10.8	10.2	10.7	8.2	8.2	7.3	8.4	8.1
Average	5.4	5.4	5.4	4.8	6.0	6.2	7.1	6.3	5.1	4.6	4.5	5.6	5.5	5.3
1988-89 Peak MW	7.1	6.8	7.1	7.4	9.6	10.8	11.5	10.9	11.4	8.7	8.7	7.9	9.0	8.7
Average MW	5.8	5.8	5.8	5.2	6.4	6.6	7.6	6.8	5.4	4.9	4.8	6.0	5.9	5.7
1989-90 Peak MW	7.6	7.2	7.6	7.9	10.2	11.6	12.3	11.7	12.2	9.3	9.3	8.4	9.6	9.3
Average MW	6.2	6.2	6.2	5.5	6.8	7.1	8.1	7.2	5.8	5.3	5.1	6.4	6.3	6.1
1990-91 Peak MW	8.1	7.7	8.1	8.4	10.9	12.3	13.2	12.5	13.0	10.0	10.0	9.0	10.3	9.9
Average MW	6.6	6.6	6.6	5.9	7.3	7.6	8.7	7.7	6.2	5.6	5.5	6.9	6.8	6.5
1991-92 Peak MW	8.7	8.2	8.7	9.0	11.7	13.2	14.1	13.3	13.9	10.6	10.6	9.6	11.0	10.6
Average MW	7.0	7.0	7.0	6.3	7.8	8.1	9.3	8.2	6.6	6.0	5.8	7.3	7.2	7.0
1992-93 Peak MW	9.3	8.8	9.3	9.6	12.4	14.0	15.0	14.2	14.8	11.3	11.3	10.2	11.7	11.3
Average MW	7.5	7.5	7.5	6.7	8.3	8.6	9.9	8.8	7.0	6.4	6.2	7.8	7.7	7.4
1993-94 Peak MW	9.9	9.3	9.9	10.2	13.2	14.9	16.0	15.1	15.8	12.1	12.1	10.9	12.4	12.0
Average MW	8.0	8.0	8.0	7.1	8.8	9.2	10.5	9.3	7.5	6.8	6.6	8.3	8.2	7.9
1994-95 Peak MW	10.5	9.9	10.5	10.8	14.1	15.9	17.0	16.1	16.8	12.8	12.8	11.6	13.2	12.8
Average MW	8.5	8.5	8.5	7.6	9.4	9.8	11.2	9.9	8.0	7.2	7.0	8.9	8.7	8.4

SOURCE: BPA, Branch of Power Resources 11/26/74.

NOTE: Delivery Point - Corvallis

TABLE VIII

LOAD ESTIMATE DATED 5/72

RAVALLI COUNTY ELECTRIC CO-OP

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1975-76	Peak MW	3.5	3.6	3.7	4.2	4.6	5.2	5.7	5.2	4.8	3.7	3.4	3.4	4.2	
	Average MW	1.8	1.9	2.0	2.3	2.6	2.9	3.0	2.9	2.5	2.2	1.9	1.9	2.3	
1976-77	Peak MW	3.7	3.8	3.9	4.4	4.8	5.5	6.0	5.5	4.3	3.9	3.6	3.6	4.4	4.3
	Average MW	1.9	2.0	2.1	2.4	2.7	3.0	3.2	3.0	2.6	2.3	2.0	2.0	2.4	2.4
1977-78	Peak MW	3.9	4.0	4.1	4.6	5.1	5.8	6.3	5.8	4.6	4.2	3.9	3.7	4.7	4.5
	Average MW	2.0	2.1	2.3	2.6	2.9	3.2	3.3	3.2	2.8	2.5	2.2	2.1	2.6	2.5
1978-79	Peak MW	4.1	4.2	4.3	4.9	5.4	6.1	6.7	6.2	4.9	4.4	4.1	4.1	4.9	4.8
	Average MW	2.1	2.3	2.4	2.7	3.0	3.4	3.5	3.4	2.9	2.6	2.3	2.3	2.7	2.7
1979-80	Peak MW	4.3	4.4	4.5	5.1	5.7	6.5	7.0	6.5	5.2	4.7	4.4	4.3	5.2	5.1
	Average MW	2.2	2.4	2.6	2.9	3.2	3.6	3.7	3.6	3.1	2.8	2.4	2.4	2.9	2.8
1980-81	Peak MW	4.5	4.6	4.7	5.4	6.0	6.9	7.4	6.9	5.5	4.9	4.7	4.5	5.5	5.3
	Average MW	2.4	2.5	2.7	3.1	3.4	3.8	3.9	3.8	3.3	2.9	2.6	2.5	3.1	3.0
1981-82	Peak MW	4.7	4.8	4.9	5.7	6.4	7.3	7.8	7.3	5.8	5.1	4.9	4.7	5.8	5.6
	Average MW	2.5	2.6	2.6	3.2	3.6	4.0	4.1	4.0	3.6	3.0	2.7	2.6	3.2	3.1
1982-83	Peak MW	5.0	5.1	5.2	6.0	6.8	7.7	8.2	7.7	6.1	5.4	5.2	4.9	6.1	5.9
	Average MW	2.6	2.7	3.0	3.4	3.8	4.2	4.3	4.2	3.8	3.2	2.9	2.7	3.4	3.3
1983-84	Peak MW	5.2	5.4	5.5	6.4	7.2	8.1	8.7	8.0	6.5	5.7	5.5	5.2	6.5	6.3
	Average MW	2.8	2.9	3.1	3.6	4.0	4.4	4.5	4.4	4.0	3.3	3.0	2.9	3.6	3.5
1984-85	Peak MW	5.5	5.7	5.8	6.7	7.6	8.5	9.1	8.5	6.8	6.0	5.8	5.5	6.8	6.6
	Average MW	2.9	3.0	3.3	3.8	4.2	4.6	4.7	4.6	4.2	3.5	3.2	3.0	3.7	3.7
1985-86	Peak MW	5.8	6.0	6.1	7.0	8.0	8.9	9.6	8.9	7.1	6.3	6.1	5.8	7.1	7.0
	Average MW	3.0	3.2	3.5	4.0	4.4	4.8	4.9	4.8	4.4	3.7	3.4	3.2	3.9	3.8

TABLE VIII, Continued

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1986-87	Peak MW	6.1	6.3	6.4	7.4	8.4	9.3	10.1	9.3	7.5	6.6	6.4	6.1	7.5	
	Average MW	3.2	3.4	3.7	4.2	4.6	5.0	5.1	5.0	4.6	3.9	3.6	3.4	4.1	
1987-88	Peak MW	6.4	6.6	6.7	7.7	8.8	9.8	10.6	9.8	7.6	6.9	6.7	6.4	7.8	7.7
	Average MW	3.3	3.5	3.9	4.4	4.8	5.3	5.4	5.3	4.8	4.1	3.7	3.5	4.3	4.2
1988-89	Peak MW	6.7	6.9	7.1	8.1	9.3	10.3	11.1	10.3	8.2	7.3	7.1	6.7	8.3	8.0
	Average MW	3.5	3.7	4.0	4.6	5.1	5.6	5.7	5.6	5.1	4.3	3.9	3.7	4.6	4.4
1989-90	Peak MW	7.0	7.3	7.4	8.5	9.7	10.8	11.6	10.8	8.6	7.6	7.4	7.0	8.6	8.4
	Average MW	3.6	3.9	4.2	4.9	5.	5.8	5.9	5.8	5.3	4.5	4.1	3.9	4.8	4.7
1990-91	Peak MW	7.4	7.6	7.8	8.9	10.2	11.3	12.2	11.3	9.0	8.0	7.8	7.4	9.1	8.8
	Average MW	3.8	4.1	4.5	5.1	5.6	6.1	6.2	6.1	5.6	4.7	4.3	4.1	5.0	4.9
1991-92	Peak MW	7.7	8.0	8.1	9.3	10.7	11.9	12.8	11.9	9.5	8.4	8.1	7.7	9.5	9.3
	Average MW	4.0	4.3	4.7	5.3	5.9	6.4	6.5	6.4	5.9	4.9	4.5	4.3	5.3	5.1
1992-93	Peak MW	8.1	8.4	8.5	9.8	11.2	12.4	13.4	12.4	9.9	8.8	8.5	8.1	10.0	9.7
	Average MW	4.2	4.5	4.9	5.6	6.2	6.7	6.9	6.7	6.2	5.2	4.8	4.5	5.5	5.4
1993-94	Peak MW	8.5	8.8	8.9	10.3	11.7	13.0	14.1	13.0	10.4	9.2	8.9	8.5	10.4	10.2
	Average MW	4.4	4.7	5.1	5.9	6.4	7.0	7.2	7.0	6.4	5.4	5.0	4.7	5.8	5.6
1994-95	Peak MW	8.9	9.2	9.4	10.7	12.3	13.7	14.7	13.7	10.9	9.7	9.4	8.9	11.0	10.7
	Average MW	4.6	4.9	5.4	6.1	6.8	7.4	7.5	7.4	6.8	5.7	5.2	4.9	6.1	5.9

SOURCE: BPA, Branch of Power Resources 11/25/74

NOTE: Delivery Point - South Darby

TABLE IX
LOAD ESTIMATE DATED 5/72
RAVALLI COUNTY ELECTRIC CO-OP

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1975-76	Peak MW	1.5	1.5	1.3	1.1	1.2	1.4	1.5	1.4	1.3	1.2	1.4	1.5	1.4	
	Average MW	.9	.9	.8	.6	.7	.8	.8	.8	.8	.7	.8	.9	.8	
1976-77	Peak MW	1.6	1.6	1.4	1.2	1.3	1.5	1.6	1.5	1.4	1.3	1.5	1.6	1.5	1.4
	Average MW	1.0	1.0	.9	.6	.7	.8	.9	.8	.8	.8	.9	1.0	.8	.8
1977-78	Peak MW	1.7	1.7	1.5	1.3	1.4	1.6	1.7	1.6	1.5	1.4	1.6	1.7	1.6	1.5
	Average MW	1.1	1.1	1.0	.7	.8	.9	1.0	.9	.9	.9	1.0	1.1	.9	.9
1978-79	Peak MW	1.8	1.8	1.6	1.4	1.6	1.8	1.8	1.7	1.6	1.6	1.7	1.8	1.7	1.6
	Average MW	1.1	1.1	1.1	.7	.8	1.0	1.0	1.0	.9	.9	1.1	1.1	1.0	1.0
1979-80	Peak WM	1.9	1.9	1.8	1.4	1.7	1.9	2.0	1.9	1.8	1.7	1.8	1.9	1.8	1.7
	Average MW	1.2	1.2	1.1	.8	.9	1.0	1.1	1.0	1.0	1.0	1.1	1.2	1.0	1.0
1980-81	Peak MW	2.0	2.0	1.9	1.5	1.8	2.0	2.1	2.0	1.9	1.8	2.0	2.1	1.9	1.9
	Average MW	1.3	1.3	1.2	.8	.9	1.0	1.2	1.1	1.1	1.0	1.2	1.3	1.1	1.1
1981-82	Peak MW	2.2	2.2	2.1	1.6	1.9	2.1	2.2	2.1	2.0	1.9	2.1	2.2	2.0	2.0
	Average MW	1.4	1.4	1.3	.9	1.0	1.2	1.3	1.2	1.2	1.1	1.3	1.4	1.2	1.2
1982-83	Peak MW	2.4	2.4	2.3	1.7	2.0	2.2	2.3	2.2	2.1	2.0	2.2	2.3	2.2	2.1
	Average MW	1.5	1.5	1.4	.9	1.0	1.2	1.3	1.2	1.2	1.1	1.3	1.4	1.2	1.2
1983-84	Peak MW	2.6	2.6	2.5	1.8	2.1	2.3	2.4	2.3	2.2	2.1	2.3	2.4	2.3	2.2
	Average MW	1.6	1.6	1.5	1.0	1.1	1.3	1.4	1.3	1.2	1.2	1.4	1.5	1.3	1.3
1984-85	Peak MW	2.8	2.8	2.7	1.9	2.3	2.5	2.6	2.5	2.4	2.3	2.5	2.6	2.5	2.4
	Average MW	1.7	1.7	1.6	1.1	1.2	1.4	1.5	1.4	1.3	1.3	1.5	1.6	1.4	1.4
1985-86	Peak MW	3.0	3.0	2.9	2.0	2.5	2.7	2.8	2.7	2.6	2.5	2.7	2.8	2.7	2.6
	Average MW	1.8	1.8	1.7	1.2	1.3	1.5	1.6	1.5	1.4	1.4	1.6	1.7	1.5	1.5

TABLE IX, Continued

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1986-87 Peak MW	3.2	3.2	3.1	2.1	2.7	2.9	3.0	2.9	2.6	2.7	2.9	3.0	2.9	
Average MW	1.9	1.9	1.8	1.3	1.4	1.6	1.7	1.6	1.5	1.5	1.7	1.8	1.6	
1987-88 Peak MW	3.4	3.4	3.3	2.3	2.9	3.1	3.2	3.1	3.0	2.9	3.1	3.2	3.1	3.0
Average MW	2.1	2.1	2.0	1.4	1.5	1.7	1.8	1.7	1.6	1.6	1.8	2.0	1.8	1.7
1988-89 Peak MW	3.7	3.7	3.6	2.5	3.1	3.3	3.4	3.3	3.2	3.1	3.3	3.4	3.3	3.2
Average MW	2.2	2.2	2.1	1.5	1.6	1.8	2.0	1.8	1.7	1.7	2.0	2.1	1.9	1.8
1989-90 Peak MW	3.9	3.9	3.8	2.6	3.2	3.5	3.7	3.5	3.4	3.3	3.5	3.7	3.5	3.4
Average MW	2.4	2.4	2.2	1.6	1.7	2.0	2.1	2.0	1.8	1.8	2.1	2.2	2.0	2.0
1990-91 Peak MW	4.2	4.2	4.1	2.8	3.5	3.8	3.9	3.8	3.6	3.5	3.8	3.9	3.8	3.6
Average MW	2.5	2.5	2.4	1.7	1.8	2.1	2.2	2.1	2.0	2.0	2.2	2.4	2.2	2.1
1991-92 Peak MW	4.5	4.5	4.3	3.8	3.7	4.0	4.2	4.0	3.9	3.7	4.0	4.2	4.0	3.9
Average MW	2.7	2.7	2.5	1.8	1.9	2.2	2.4	2.2	2.1	2.1	2.4	2.5	2.3	2.2
1992-93 Peak MW	4.8	4.8	4.6	3.2	4.0	4.3	4.5	4.3	4.1	4.0	4.3	4.5	4.3	4.1
Average MW	2.9	2.9	2.7	1.9	2.1	2.4	2.6	2.4	2.2	2.2	2.6	2.7	2.5	2.4
1993-94 Peak MW	5.1	5.1	4.9	3.4	4.2	4.6	4.8	4.6	4.4	4.2	4.6	4.8	4.6	4.4
Average MW	3.1	3.1	2.9	2.0	2.2	2.5	2.7	2.5	2.4	2.4	2.7	2.9	2.6	2.5
1994-95 Peak MW	5.4	5.4	5.2	3.6	4.5	4.9	5.1	4.9	4.7	4.5	4.9	5.1	4.8	4.7
Average MW	3.3	3.3	3.1	2.2	2.3	2.7	2.9	2.7	2.5	2.5	2.9	3.1	2.8	2.7

SOURCE: BPA, Branch of Power Resources 11/25/74

NOTE: Delivery Point - Grantsdale

TABLE X

LOAD ESTIMATE DATED 3/72

RAVALLI COUNTY ELECTRIC CO OP

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1975-76 Peak MW	1.4	1.8	1.5	1.7	2.0	2.0	2.2	2.1	1.9	1.8	1.7	1.7	1.8	
Average MW	1.1	1.1	1.1	1.0	1.1	1.3	1.2	1.3	1.2	1.0	1.2	1.2	1.2	
1976-77 Peak MW	1.5	1.8	1.7	1.8	2.1	2.1	2.4	2.3	2.1	2.0	1.8	1.8	1.9	1.9
Average MW	1.2	1.2	1.2	1.1	1.2	1.3	1.4	1.4	1.3	1.2	1.3	1.2	1.2	1.2
1977-78 Peak MW	1.7	2.0	1.8	1.8	2.3	2.3	2.6	2.4	2.3	2.1	2.0	2.0	2.1	2.0
Average MW	1.3	1.3	1.3	1.2	1.3	1.4	1.5	1.4	1.5	1.2	1.4	1.4	1.3	1.3
1978-79 Peak MW	1.8	2.1	2.0	1.9	2.5	2.5	2.9	2.6	2.5	2.4	2.2	2.0	2.3	2.2
Average MW	1.4	1.4	1.4	1.2	1.5	1.5	1.6	1.6	1.6	1.3	1.5	1.5	1.5	1.4
1979-80 Peak MW	2.0	2.3	2.1	2.2	2.7	2.8	3.1	2.8	2.7	2.5	2.4	2.2	2.5	2.4
Average MW	1.5	1.5	1.5	1.3	1.6	1.6	1.7	1.6	1.6	1.5	1.6	1.5	1.5	1.5
1980-81 Peak MW	2.1	2.4	2.2	2.4	2.9	3.0	3.3	3.1	2.9	2.7	2.5	2.3	2.6	2.6
Average MW	1.7	1.7	1.7	1.5	1.7	1.8	1.9	1.8	1.8	1.5	1.8	1.7	1.7	1.6
1981-82 Peak MW	2.3	2.6	2.3	2.6	3.2	3.3	3.6	3.3	3.2	2.9	2.7	2.5	2.9	2.8
Average MW	1.7	1.7	1.7	1.5	1.8	2.0	2.0	2.0	1.9	1.6	1.8	1.8	1.8	1.7
1982-83 Peak MW	2.4	2.8	2.5	2.8	3.5	3.5	3.9	3.5	3.5	3.1	3.0	2.8	3.1	3.0
Average MW	1.9	1.9	1.8	1.7	1.8	2.1	2.2	2.2	2.0	1.8	1.9	1.9	1.9	1.9
1983-84 Peak MW	2.7	3.1	2.8	3.1	3.8	3.8	4.3	3.9	3.7	3.4	3.3	3.0	3.4	3.3
Average MW	2.1	2.1	2.0	1.8	2.0	2.2	2.3	2.3	2.2	1.8	2.1	2.1	2.1	2.0
1984-85 Peak MW	2.9	3.3	3.0	3.4	4.1	4.2	4.6	4.2	4.0	3.7	3.5	3.3	3.7	3.5
Average MW	2.2	2.2	2.1	1.9	2.2	2.4	2.5	2.5	2.4	2.0	2.2	2.2	2.2	2.1
1985-86 Peak MW	3.1	3.5	3.2	3.7	4.4	4.5	4.9	4.5	4.3	4.0	3.8	3.5	3.9	3.8
Average MW	2.4	2.4	2.3	2.0	2.4	2.6	2.7	2.7	2.6	2.1	2.4	2.4	2.4	2.3

TABLE X, Continued

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1986-87	Peak MW	3.3	3.8	3.4	4.8	4.7	4.8	5.3	4.8	4.6	4.3	4.1	3.8	4.2	
	Average MW	2.6	2.6	2.5	2.2	2.6	2.8	2.9	2.9	2.8	2.3	2.6	2.6	2.6	
1987-88	Peak MW	3.6	4.1	3.7	4.3	5.1	5.2	5.7	5.2	5.0	4.6	4.4	4.1	4.6	4.4
	Average MW	2.8	2.8	2.7	2.3	2.8	3.0	3.1	3.1	3.0	2.4	2.8	2.8	2.8	2.7
1988-89	Peak MW	3.9	4.4	4.0	4.6	5.5	5.6	6.1	5.6	5.4	5.0	4.7	4.4	4.9	4.7
	Average MW	3.0	3.0	2.9	2.5	3.0	3.2	3.4	3.4	3.2	2.6	3.0	3.0	3.0	2.9
1989-90	Peak MW	4.1	4.7	4.3	5.0	5.9	6.0	6.6	6.0	5.8	5.4	5.1	4.7	5.3	5.1
	Average MW	3.2	3.2	3.1	2.7	3.2	3.5	3.5	3.6	3.5	2.8	3.2	3.2	3.2	3.1
1990-91	Peak MW	4.5	5.0	4.6	5.3	6.3	6.5	7.0	6.5	6.2	5.7	5.5	5.0	5.7	5.5
	Average MW	3.4	3.4	3.3	2.9	3.4	3.7	3.9	3.9	3.7	3.0	3.4	3.4	3.4	3.3
1991-92	Peak MW	4.8	5.4	4.9	5.7	6.8	6.9	7.5	6.9	6.6	6.2	5.8	5.4	6.1	5.9
	Average MW	3.7	3.7	3.5	3.1	3.7	4.0	4.2	4.2	4.0	3.2	3.7	3.7	3.7	3.8
1992-93	Peak MW	5.1	5.8	5.3	6.1	7.3	7.4	8.1	7.4	7.1	6.6	6.3	5.8	6.5	6.3
	Average MW	4.0	4.0	3.8	3.3	4.0	4.3	4.5	4.5	4.3	3.5	4.0	4.0	4.0	3.9
1993-94	Peak MW	5.5	6.2	5.6	6.5	7.8	7.9	8.6	7.9	7.6	7.1	6.7	6.2	7.0	6.7
	Average MW	4.2	4.2	4.1	3.5	4.2	4.6	4.8	4.8	4.6	3.7	4.2	4.2	4.3	4.1
1994-95	Peak MW	5.8	6.6	6.0	7.0	8.3	8.5	9.2	8.5	8.1	7.5	7.2	6.6	7.4	7.2
	Average MW	4.5	4.5	4.3	3.8	4.5	4.9	5.1	5.1	4.9	4.0	4.5	4.5	4.5	4.4

SOURCE: BPA, Branch of Power Resources 11/25/74

NOTE: Delivery Point - Stevensville

TABLE XI

LOAD ESTIMATE DATED 3/72
RAVALLI COUNTY ELECTRIC CO-OP

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1975-76 Peak MW	1.5	1.5	1.3	1.5	1.5	1.7	1.9	1.7	1.4	1.2	1.3	1.5	1.5	
Average MW	1.1	1.1	.9	.7	.9	1.1	1.2	1.0	.9	.8	.8	1.1	1.0	
1976-77 Peak MW	1.7	1.7	1.5	1.3	1.6	1.9	2.1	1.8	1.5	1.3	1.3	1.7	1.6	1.6
Average MW	1.2	1.2	1.0	.8	.9	1.2	1.3	1.1	.9	.8	.8	1.2	1.0	1.0
1977-78 Peak MW	1.8	1.8	1.6	1.4	1.7	2.0	2.3	1.9	1.6	1.4	1.4	1.8	1.7	1.7
Average MW	1.3	1.3	1.1	.8	1.0	1.3	1.4	1.2	1.0	.9	.9	1.3	1.1	1.1
1978-79 Peak MW	2.0	2.0	1.8	1.6	1.9	2.2	2.5	2.1	1.7	1.5	1.5	1.9	1.9	1.8
Average MW	1.4	1.4	1.2	.9	1.1	1.5	1.6	1.3	1.1	1.0	1.0	1.4	1.2	1.2
1979-80 Peak MW	2.1	2.1	1.9	1.7	2.0	2.4	2.7	2.3	1.8	1.6	1.5	2.0	2.0	1.9
Average MW	1.5	1.5	1.3	1.0	1.2	1.6	1.7	1.5	1.2	1.1	1.0	1.5	1.3	1.3
1980-81 Peak MW	2.3	2.3	2.1	1.9	2.2	2.6	2.9	2.5	1.9	1.7	1.6	2.2	2.2	2.1
Average MW	1.6	1.6	1.4	1.1	1.3	1.7	1.0	1.6	1.3	1.2	1.1	1.6	1.4	1.4
1981-82 Peak MW	2.4	2.4	2.2	2.0	2.3	2.8	3.1	2.7	2.0	1.8	1.7	2.3	2.3	2.2
Average MW	1.7	1.7	1.5	1.2	1.4	1.8	2.0	1.7	1.4	1.3	1.2	1.7	1.5	1.5
1982-83 Peak MW	2.6	2.6	2.4	2.2	2.5	3.0	3.3	2.9	2.1	1.9	1.8	2.4	2.5	2.4
Average MW	1.9	1.9	1.6	1.3	1.5	2.0	2.1	1.8	1.5	1.4	1.3	1.9	1.7	1.6
1983-84 Peak MW	2.7	2.7	2.5	2.3	2.6	3.2	3.5	3.1	2.3	2.0	1.8	2.6	2.6	2.5
Average MW	2.0	2.0	1.7	1.4	1.6	2.2	2.3	2.0	1.6	1.5	1.4	2.0	1.8	1.7
1984-85 Peak MW	2.9	2.9	2.7	2.5	2.8	3.4	3.7	3.3	2.4	2.1	1.9	2.7	2.8	2.7
Average MW	2.2	2.2	1.8	1.5	1.8	2.3	2.5	2.1	1.8	1.6	1.5	2.2	2.0	1.9
1985-86 Peak MW	3.1	3.1	2.9	2.7	3.0	3.7	4.0	3.6	2.6	2.3	2.0	2.9	3.0	2.9
Average MW	2.4	2.4	1.9	1.6	1.9	2.5	2.7	2.3	1.9	1.7	1.6	2.4	2.1	2.0

TABLE XI, Continued

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	FY.AV	CY.AV
1986-87 Peak MW	3.3	3.3	3.1	2.9	3.2	4.0	4.3	3.9	2.8	2.5	2.2	3.1	3.2	
Average MW	2.6	2.6	2.1	1.7	2.1	2.7	2.9	2.5	2.1	1.8	1.7	2.6	2.3	
1987-88 Peak MW	3.6	3.6	3.4	3.1	3.5	4.3	4.7	4.2	3.0	2.7	2.3	3.4	3.5	3.4
Average MW	2.8	2.8	2.2	1.9	2.2	2.9	3.1	2.7	2.2	2.0	1.9	2.8	2.5	2.4
1988-89 Peak MW	3.9	3.9	3.6	3.4	3.8	4.6	5.0	4.5	3.3	2.9	2.5	3.6	3.7	3.8
Average MW	3.0	3.0	2.4	2.0	2.4	3.1	3.4	2.9	2.4	2.1	2.0	3.0	2.6	2.5
1989-90 Peak MW	4.2	4.2	3.9	3.6	4.1	5.0	5.4	4.9	3.5	3.1	2.7	3.9	4.0	3.9
Average MW	3.2	3.2	2.6	2.2	2.6	3.4	3.6	3.1	2.6	2.3	2.2	3.2	2.8	2.7
1990-91 Peak MW	4.5	4.5	4.2	3.9	4.4	5.4	5.8	5.2	3.8	3.3	2.9	4.2	4.3	4.2
Average MW	3.5	3.5	2.8	2.3	2.8	3.6	3.9	3.3	2.8	2.5	2.3	3.5	3.1	3.0
1991-92 Peak MW	4.8	4.8	4.5	4.2	4.7	5.8	6.3	5.6	4.1	3.6	3.1	4.5	4.7	4.5
Average MW	3.8	3.8	3.0	2.5	3.0	3.9	4.2	3.6	3.0	2.7	2.5	3.8	3.3	3.2
1992-93 Peak M W	5.2	5.2	4.9	4.5	5.0	6.2	6.7	6.0	4.4	3.9	3.4	4.9	5.0	4.8
Average MW	4.0	4.0	3.2	2.7	3.2	4.2	4.5	3.9	3.2	2.9	2.7	4.0	3.5	3.4
1993-94 Peak MW	5.6	5.6	5.2	4.9	5.4	6.7	7.2	6.5	4.7	4.1	3.6	5.2	5.4	5.2
Average MW	4.3	4.3	3.4	2.9	3.4	4.5	4.9	4.1	3.4	3.1	2.9	4.3	3.8	3.7
1994-95 Peak MW	6.0	6.0	5.6	5.2	5.8	7.1	7.7	6.9	5.0	4.4	3.9	5.6	5.8	5.6
Average MW	4.6	4.6	3.7	3.1	3.7	4.8	5.2	4.4	3.7	3.3	3.1	4.6	4.1	3.9

SOURCE: BPA, Branch of Power Resources 11/25/74

NOTE: DELIVERY POINT - Victor

TABLE XII
ELEVEN-YEAR LOAD FORECAST
9-570 LOLO (3000 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)		TOTAL LOAD(KW)
1965	1200.	1288.	0.		1288.
1966	1250.	1438.	0.		1438.
1967	1760.	1605.	0.		1605.
1968	1950.	1792.	0.		1792.
1969	1880.	2000.	0.		2000.
1970	4750.	2233.	1300.		3533.
1971	3200.	2493.	1300.		3793.
1972	4200.	2783.	1300.		4083.
1973	4250.	3107.	1300.		4407.
1974	4608.	3469	1300.		4769.
1975		3872	1300.		5172.
1976		4323.	1300.	5080	5623.
1977		4826.	1300.	5334	6126.
1978		5387.	1300.	5601	6687.
1979		6014.	1300.	5881	7314.
1980		6714.	1300.	6175	8014.
1981		7495.	1300.	6484	8795.
1982		8367.	1300.	6808	9667.
1983		9341.	1300.	7149	10641.
1984		10427.	1300.	7506	11727.
1985		11641.	1300.	7881	12941.

SOURCE: Montana Power Company

NOTE: Growth rate 11.6 per cent based on data from 1965 to 1974. Projected growth rate is too high for last three years. Growth rate was changed to reflect loads of last three years.

TABLE XIII
ELEVEN-YEAR LOAD FORECAST
9-580 FLORENCE (500 KVA:150 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1955	120.	106.	0.	106.
1956	150.	116.	0.	116.
1957	130.	127.	0.	127.
1958	140.	140.	0.	140.
1959	170.	154.	0.	154.
1960	152.	169.	0.	169.
1961	190.	186.	0.	186.
1962	189.	204.	0.	204.
1963	191.	224.	0.	224.
1964	150.	246.	0.	246.
1965	215.	271.	0.	271.
1966	340.	298.	0.	298.
1967	390.	327.	0.	327.
1968	390.	359.	0.	359.
1969	360.	395.	0.	395.
1970	410.	434.	0.	434.
1971	425.	477.	0.	477.
1972	560.	524.	0.	524.
1973	725.	576.	0.	576.
1974	720.	632.	0.	632.
1975		695.	0.	695.
1976		764.	0.	764.
1977		839.	0.	839.
1978		922.	0.	922.
1979		1013.	0.	1013.
1980		1113.	0.	1113.
1981		1223.	0.	1223.
1982		1344.	0.	1344.
1983		1477.	0.	1477.
1984		1623.	0.	1623.
1985		1783.	0.	1783.

SOURCE: Montana Power Company

NOTE: Growth rate 9.9 per cent based on data from 1955 to 1974. New estimates were run when an error in the reported peak for 1974 was corrected.

TABLE XIV
ELEVEN-YEAR LOAD FORECAST
9-590 STEVENSVILLE (2500 KVA)

YEAR	LOAD (KW)	FITTED LOAD (KW)	ADDED BLOCK LOAD (KW)	TOTAL LOAD (KW)
1950	470.	616.	0.	616.
1951	510.	649.	0.	649.
1952	750.	684.	0.	684.
1953	840.	721.	0.	721.
1954	810.	759.	0.	759.
1955	940.	800.	0.	800.
1956	1010.	843.	0.	843.
1957	1010.	888.	0.	888.
1958	1080.	935.	0.	935.
1959	1000.	986.	0.	986.
1960	1040.	1038.	0.	1038.
1961	1100.	1094.	0.	1094.
1962	1150.	1153.	0.	1153.
1963	1100.	1214.	0.	1214.
1964	1050.	1280.	0.	1280.
1965	1410.	1348.	0.	1348.
1966	1200.	1420.	0.	1420.
1967	1430.	1496.	0.	1496.
1968	1670.	1577.	0.	1577.
1969	1330.	1661.	0.	1661.
1970	1320.	1750.	0.	1750.
1971	2050.	1844.	0.	1844.
1972	2400.	1943.	0.	1943.
1973	2300.	2047.	0.	2047.
1974	2304.	2157.	0.	2157.
1975		2272.	0.	2272.
1976		2394.	0.	2394.
1977		2522.	0.	2522.
1978		2657.	0.	2657.
1979		2800.	0.	2800.
1980		2950.	0.	2950.
1981		3108.	0.	3108.
1982		3274.	0.	3274.
1983		3450.	0.	3450.
1984		3635.	0.	3635.
1985		3829.	0.	3829.

SOURCE: Montana Power Company

NOTE: Growth rate 5.4 per cent based on data from 1950 to 1974.

TABLE XV
ELEVEN-YEAR LOAD FORECAST
9-610 STEVENSVILLE W/BPA (1500 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1952	130.	222.	0.	222.
1953	250.	242.	0.	242.
1954	210.	263.	0.	263.
1955	360.	287.	0.	287.
1956	380.	312.	0.	312.
1957	300.	339.	0.	339.
1958	440.	369.	0.	369.
1959	500.	402.	0.	402.
1960	420.	437.	0.	437.
1961	670.	476.	0.	476.
1962	530.	518.	0.	518.
1963	540.	563.	0.	563.
1964	600.	613.	0.	613.
1965	780.	667.	0.	667.
1966	790.	726.	0.	726.
1967	800.	790.	0.	790.
1968	780.	859.	0.	859.
1969	860.	935.	0.	935.
1970	1600.	1017.	700.	1717.
1971	2050.	1107.	1000.	2107.
1972	2600.	1204.	1400.	2604.
1973	2650.	1310.	1400.	2710.
1974	2744.	1426.	1400.	2826.
1975		1551.	1400.	2951.
1976		1688.	1400.	3088.
1977		1837.	1400.	3237.
1978		1999.	1400.	3399.
1979		2175.	1400.	3575.
1980		2366.	1400.	3766.
1981		2575.	1400.	3975.
1982		2802.	1400.	4202.
1983		3049.	1400.	4449.
1984		3317.	1400.	4717.
1985		3609.	1400.	5009.

SOURCE: Montana Power Company

NOTE: Growth rate 8.8 per cent based on data from 1952 to 1974.

TABLE XVI
ELEVEN-YEAR LOAD FORECAST
9-620 VICTOR (1000 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1964	710.	724.	0.	724.
1965	725.	726.	0.	726.
1966	750.	729.	0.	729.
1967	640.	731.	0.	731.
1968	730.	734.	0.	734.
1969	1050.	736.	0.	736.
1970	680.	739.	0.	739.
1971	740.	742.	0.	742.
1972	650.	744.	0.	744.
1973	625.	747.	0.	747.
1974	900.	749.	0.	749.
1975		752.	0.	752.
1976		755.	0.	755.
1977		757.	0.	757.
1978		760.	0.	760.
1979		762.	0.	762.
1980		765.	0.	765.
1981		768.	0.	768.
1982		770.	0.	770.
1983		773.	0.	773.
1984		776.	0.	776.
1985		779.	0.	779.

SOURCE: Montana Power Company

NOTE: Growth rate 0.3 per cent based on data from 1964 to 1974.

TABLE XVII
ELEVEN-YEAR LOAD FORECAST
9-639 GRANTSDALE W/BPA (1000 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)		TOTAL LOAD(KW)
1972	1450.	1213.	0.		1213.
1973	820.	1168.	0.		1168.
1974	1344.	1125.	0.		1125.
1975		1083.	0.		1083.
1976		1042.	0.	1600	1042.
1977		1004.	0.	1700	1004.
1978		966.	0.	1800	966.
1979		930.	0.	1900	930.
1980		896.	0.	2000	896.
1981		862.	0.	2200	862.
1982		830.	0.	2400	830.
1983		799.	0.	2600	799.
1984		769.	0.	2800	769.
1985		741.	0.	3000	741.

SOURCE: Montana Power Company

NOTE: Growth rate -3.7 per cent based on data from 1972 to 1974. New estimate provided by Bonneville Power Administration.

TABLE XVIII
ELEVEN-YEAR LOAD FORECAST
9-640 HAMILTON RURAL (2500 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1967	3600.	3557.	0.	3557.
1968	3500.	3636.	0.	3636.
1969	3800.	3716.	0.	3716.
1970	3900.	3799.	0.	3799.
1971	2700.	3883.	-1000.	2883.
1972	3100.	3969.	-1000.	2969.
1973	3200.	4056.	-1000.	3056.
1974	3008.	4146.	-1000.	3146.
1975		4238.	-1000.	3238.
1976		4332.	-1000.	3332.
1977		4428.	-1000.	3428.
1978		4526.	-1000.	3526.
1979		4626.	-1000.	3626.
1980		4728.	-1000.	3728.
1981		4833.	-1000.	3833.
1982		4940.	-1000.	3940.
1983		5049.	-1000.	4049.
1984		5161.	-1000.	4161.
1985		5275.	-1000.	4275.

SOURCE: Montana Power Company

NOTE: Growth rate 2.2 per cent based on data from 1967 to 1974. Load growth slightly altered to reflect loss of load in 1971 which was transferred to new substation.

TABLE XIX
ELEVEN-YEAR LOAD FORECAST
9-641 HAMILTON RURAL (2500 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1967	1600.	1566.	0.	1566.
1968	1880.	1713.	0.	1713.
1969	1770.	1873.	0.	1873.
1970	2000.	2049.	0.	2049.
1971	2000.	2241.	0.	2241.
1972	2400.	2452.	0.	2452.
1973	2900.	2682.	0.	2682.
1974	3024.	2934.	0.	2934.
1975		3209.	0.	3209.
1976		3510.	0.	3510.
1977		3840.	0.	3840.
1978		4200.	0.	4200.
1979		4594.	0.	4594.
1980		5026.	0.	5026.
1981		5497.	0.	5497.
1982		6013.	0.	6013.
1983		6578.	0.	6578.
1984		7195.	0.	7195.
1985		7871.	0.	7871.

SOURCE: Montana Power Company

NOTE: Growth rate 9.4 per cent based on data from 1967 to 1974.

TABLE XX
ELEVEN-YEAR LOAD FORECAST
9-650 CORVALLIS (2500 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1952	370.	470.	0.	470.
1953	475.	494.	0.	494.
1954	540.	518.	0.	518.
1955	540.	544.	0.	544.
1956	650.	572.	0.	572.
1957	630.	601.	0.	601.
1958	630.	631.	0.	631.
1959	850.	663.	0.	663.
1960	660.	696.	0.	696.
1961	725.	731.	0.	731.
1962	800.	768.	0.	768.
1963	800.	806.	0.	806.
1964	820.	847.	0.	847.
1965	870.	890.	0.	890.
1966	900.	934.	0.	934.
1967	1200.	982.	0.	982.
1968	850.	1031.	0.	1031.
1969	1060.	1083.	0.	1083.
1970	1090.	1137.	0.	1137.
1971	1200.	1195.	0.	1195.
1972	1270.	1255.	0.	1255.
1973	1350.	1318.	0.	1318.
1974	1350.	1384.	0.	1384.
1975		1454.	0.	1454.
1976		1527.	0.	1527.
1977		1604.	0.	1604.
1978		1685.	0.	1685.
1979		1769.	0.	1769.
1980		1859.	0.	1859.
1981		1952.	0.	1952
1982		2050.	0.	2050.
1983		2154.	0.	2154.
1984		2262.	0.	2262.
1985		2376.	0.	2376.

SOURCE: Montana Power Company

NOTE: Growth rate 5.0 per cent based on data from 1952 to 1974.

TABLE XXI
ELEVEN-YEAR LOAD FORECAST
9-660 DARBY

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)		TOTAL LOAD(KW)
1948	530.	520.	0.		520.
1949	600.	584.	0.		584.
1950	510.	657.	0.		657.
1951	550.	738.	0.		738.
1952	630.	829.	0.		829.
1953	700.	932.	0.		932.
1954	1050.	1047.	0.		1047.
1955	1300.	1177.	0.		1177.
1956	1500.	1323.	0.		1323.
1957	1700.	1487.	0.		1487.
1958	1900.	1671.	0.		1671.
1959	2400.	1878.	0.		1878.
1960	2400.	2111.	0.		2111.
1961	2700.	2372.	0.		2372.
1962	3150.	2666.	0.		2666.
1963	3600.	2997.	0.		2997.
1964	3800.	3368.	0.		3368.
1965	4400.	3785.	0.		3785.
1966	4800.	4254.	0.		4254.
1967	5500.	4781.	0.		4781.
1968	6000.	5373.	0.		5373.
1969	6500.	6039.	0.		6039.
1970	5800.	6787.	0.		6787.
1971	7400.	7628.	0.		7628.
1972	7500.	8573.	0.		8573.
1973	7500.	9635.	0.		9635.
1974	7250.	10828.	0.		10828.
1975		12170.	0.		12170.
1976		13677.	0.	7725	13677.
1977		15372.	0.	7957	15372.
1978		17276	0.	8195	17276.
1979		19416.	0.	8441	19416.
1980		21822.	0.	8695	21822.
1981		24525.	0.	8955	24525.
1982		27563.	0.	9224	27563.
1983		30978.	0.	9501	30978.
1984		34816.	0.	9786	34816.
1985		39129.	0.	10079	39129.

SOURCE: Montana Power Company

NOTE: Growth rate 12.4 per cent based on data from 1948 to 1974. The growth rate was reduced to 3% to reflect the decrease in growth from 1971.

TABLE XXII
ELEVEN-YEAR LOAD FORECAST
9-690 LOLO W/BPA

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1969	1250.	2217.	0.	2217.
1970	1780.	2429.	0.	2429.
1971	2600.	2661.	0.	2661.
1972	3000.	2915.	0.	2915.
1973	3250.	3194.	0.	3194.
1974	3432.	3499.	0.	3499.
1975		3833.	0.	3833.
1976		4200.	0.	4200.
1977		4601.	0.	4601.
1978		5041.	0.	5041.
1979		5523.	0.	5523.
1980		6051.	0.	6051.
1981		6629.	0.	6629.
1982		7263.	0.	7263.
1983		7957.	0.	7957.
1984		8717.	0.	8717.
1985		9550.	0.	9550.

SOURCE: Montana Power Company

NOTE: Growth rate 9.6 per cent based on data from 1971 to 1974.

TABLE XXIII
ELEVEN-YEAR LOAD FORECAST
9-730 CORVALLIS W/BPA (5000 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1952	800.	952.	0.	952.
1953	940.	1031.	0.	1031.
1954	950.	1117.	0.	1117.
1955	1300.	1210.	0.	1210.
1956	1300.	1310.	0.	1310.
1957	1490.	1419.	0.	1419.
1958	1590.	1537.	0.	1537.
1959	1980.	1665.	0.	1665.
1960	1790.	1804.	0.	1804.
1961	2150.	1954.	0.	1954.
1962	2500.	2116.	0.	2116.
1963	2500.	2292.	0.	2292.
1964	2150.	2483.	0.	2483.
1965	2900.	2689.	0.	2689.
1966	3350.	2913.	0.	2913.
1967	3100.	3155.	0.	3155.
1968	3250.	3417.	0.	3417.
1969	3350.	3702.	0.	3702.
1970	3900.	4009.	0.	4009.
1971	5000.	4343.	0.	4343.
1972	5400.	4704.	0.	4704.
1973	4700.	5095.	0.	5095.
1974	4144.	5519.	0.	5519.
1975		5978.	0.	5978.
1976		6475.	0.	6475.
1977		7013.	0.	7013.
1978		7597.	0.	7597.
1979		8228.	0.	8228.
1980		8913.	0.	8913.
1981		9654.	0.	9654.
1982		10457	0.	10457.
1983		11326.	0.	11326.
1984		12268.	0.	12268.
1985		13288.	0.	13288.

SOURCE: Montana Power Company

NOTE: Growth rate 8.3 per cent based on data from 1952 to 1974.

ELEVEN-YEAR LOAD FORECAST
9-740 DARBY W/BPA

YEAR	LOAD (KW)	FITTED LOAD (KW)	ADDED BLOCK LOAD (KW)	TOTAL LOAD (KW)
1951	100.	1310.	0.	1310.
1952	120.	1385.	0.	1385.
1953	200.	1464.	0.	1464.
1954	325.	1547.	0.	1547.
1955	370.	1635.	0.	1635.
1956	510.	1729.	0.	1729.
1957	640.	1827.	0.	1827.
1958	720.	1931.	0.	1931.
1959	860.	2041.	0.	2041.
1960	975.	2158.	0.	2158.
1961	1220.	2280.	0.	2280.
1962	1360.	2410.	0.	2410.
1963	1620.	2548.	0.	2548.
1964	1680.	2693.	0.	2693.
1965	2100.	2846.	0.	2846.
1966	2600.	3008.	0.	3008.
1967	3250.	3180.	0.	3180.
1968	3300.	3361.	0.	3361.
1969	3250.	3552.	0.	3552.
1970	3700.	3755.	0.	3755.
1971	4500.	3969.	0.	3969.
1972	5500.	4195.	1000.	5195.
1973	4300.	4434.	0.	4434.
1974	4424.	4686.	0.	4686.
1975		4953.	0.	4953.
1976		5235.	0.	5235.
1977		5534.	0.	5534.
1978		5849.	0.	5849.
1979		6182.	0.	6182.
1980		6534.	0.	6534.
1981		6907.	0.	6907.
1982		7300.	0.	7300.
1983		7716.	0.	7716.
1984		8155.	0.	8155.
1985		8620.	0.	8620.

SOURCE: Montana Power Company

NOTE: Growth rate 5.7 per cent based on data from 1967 to 1974. New estimate made negating the effect of the exceptionally high peak in 1972.

TABLE XXV
ELEVEN-YEAR LOAD FORECAST
1 1-360 PHILIPSBURG CITY (2500 KVA)

YEAR	LOAD (KW)	FITTED LOAD (KW)	ADDED BLOCK LOAD (KW)		TOTAL LOAD (KW)
1955	950.	1216.	0.		1216.
1956	1050.	1213.	0.		1213.
1957	1090.	1211.	0.		1211.
1958	1200.	1208.	0.		1208.
1959	1100.	1206.	0.		1206.
1960	1300.	1203.	0.		1203.
1961	1400.	1201.	0.		1201.
1962	1450.	1199.	0.		1199.
1963	1410.	1196.	0.		1196.
1964	1330.	1194.	0.		1194.
1965	1250.	1191.	0.		1191.
1966	1070.	1189.	0.		1189.
1967	1740.	1186.	0.		1186.
1968	1750.	1184.	0.		1184.
1969	2200.	1182.	0.		1182.
1970	1070.	1179.	0.		1179.
1971	1260.	1177.	0.		1177.
1972	1300.	1175.	0.		1175.
1973	1160.	1172.	0.		1172.
1974	1104.	1170.	0.		1170.
1975		1167.	0.		1167.
1976		1165.	0.	1121	1165.
1977		1163.	0.	1130	1163.
1978		1160.	0.	1139	1160.
1979		1158.	0.	1148	1158.
1980		1156.	0.	1157	1156.
1981		1153.	0.	1166	1153.
1982		1151.	0.	1175	1151.
1983		1149.	0.	1186	1149.
1984		1146.	0.	1194	1146.
1985		1144.	0.	1203	1144.

SOURCE: Montana Power Company

NOTE: Growth rate -0.2 per cent based on data from 1970 to 1974. Decrease in load for last 2 years was due to removing load from this substation and adding it to the 25 kV circuit. A slight growth is expected.

TABLE XXVI
ELEVEN-YEAR LOAD FORECAST
1 1-550 PHILIPSBURG AUTO (3000 KVA)

YEAR	LOAD(KW)	FITTED LOAD(KW)	ADDED BLOCK LOAD(KW)	TOTAL LOAD(KW)
1965	1450.	2306.	0.	2306.
1966	4750.	2337.	0.	2337.
1967	2450.	2369.	0.	2369.
1968	1150.	2401.	0.	2401.
1969	2600.	2434.	0.	2434.
1970	3450.	2467.	0.	2467.
1971	3200.	2501.	0.	2501.
1972	2950.	2535.	0.	2535.
1973	2600.	2569.	0.	2569.
1974	1845.	2604.	0.	2604.
1975		2640.	0.	2640.
1976		2676.	0.	2676.
1977		2712.	0.	2712.
1978		2749.	0.	2749.
1979		2787.	0.	2787.
1980		2825.	0.	2825.
1981		2863.	0.	2863.
1982		2902.	0.	2902.
1983		2942.	0.	2942.
1984		2982.	0.	2982.
1985		3022.	0.	3022.

SOURCE: Montana Power Company

NOTE: Growth rate 1.4 per cent based on data from 1965 to 1974.

APPENDIX B

APPENDIX B

High Pressure Oil-Filled Pipe Type Cable

In 1973 the most widely used underground transmission cable in the United States was the high pressure oil-filled pipe type. Approximately 2000 circuit miles were in operation at voltages from 69 kV to 345 kV with power transmission capabilities from 100 MVA to 600 MVA.

High pressure oil-filled pipe type cable consists of three paper insulated conductors contained in a corrosion protected steel pipe (see Figure 1). The integrity of the insulation is assured by filling the pipe with insulating oil and maintaining the oil at a static pressure on the order of 200 psi.

A pumping plant maintains pressure on the system and provides a storage tank for oil expelled from the pipe during heating cycles. Splices are required for every two to three thousand feet of cable (see Figure 2). The pipe which contains the cable is shipped in sections and welded together at the site.

High Pressure Gas-Filled Pipe Type Cable

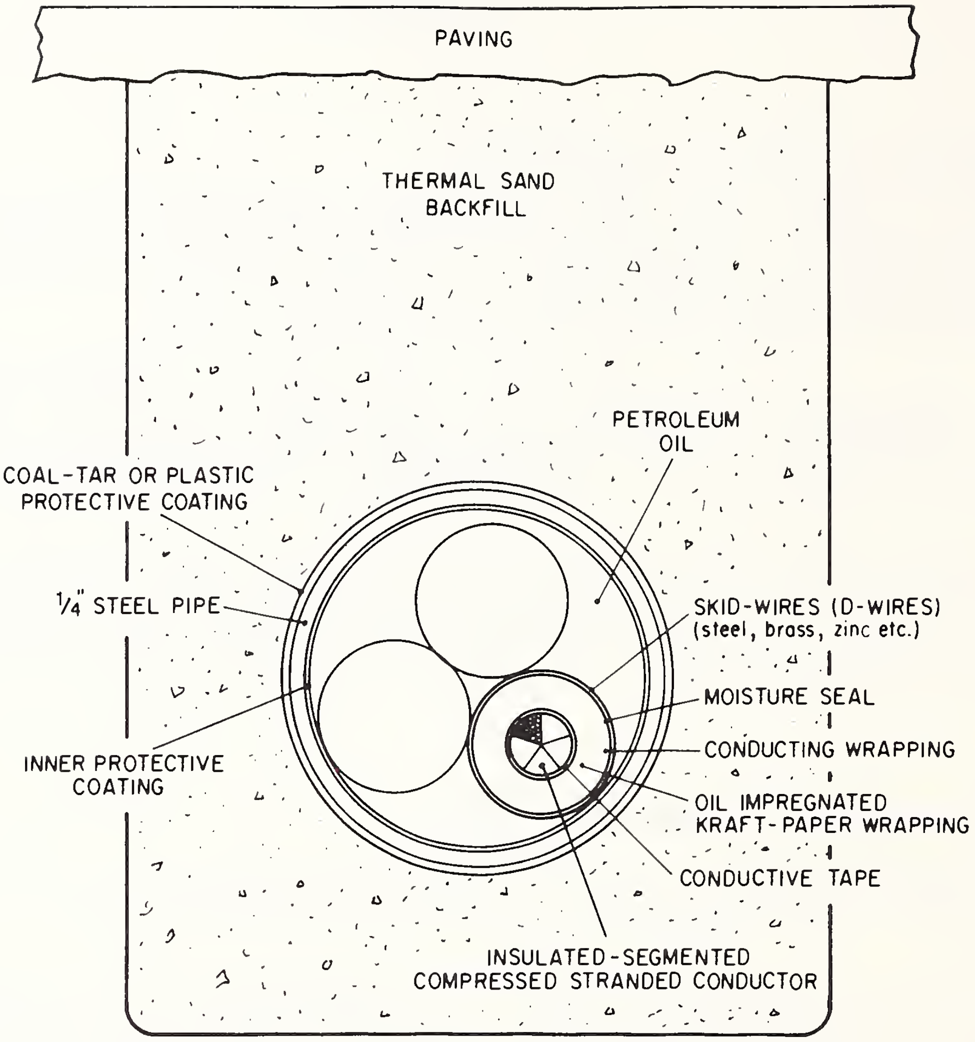
This type of cable is similar to the high pressure oil-filled pipe type cable, except nitrogen gas is used instead of insulating oil.

With the gas type cable, there is no requirement for oil stops to prevent excessive hydraulic pressure due to differences in elevation. Also, oil pumping stations are eliminated. In place of oil pumping stations, nitrogen gas supplies and pressure regulating equipment are required.

Self Contained, Low and Medium Pressure, Paper Insulated, Oil-Filled Cable

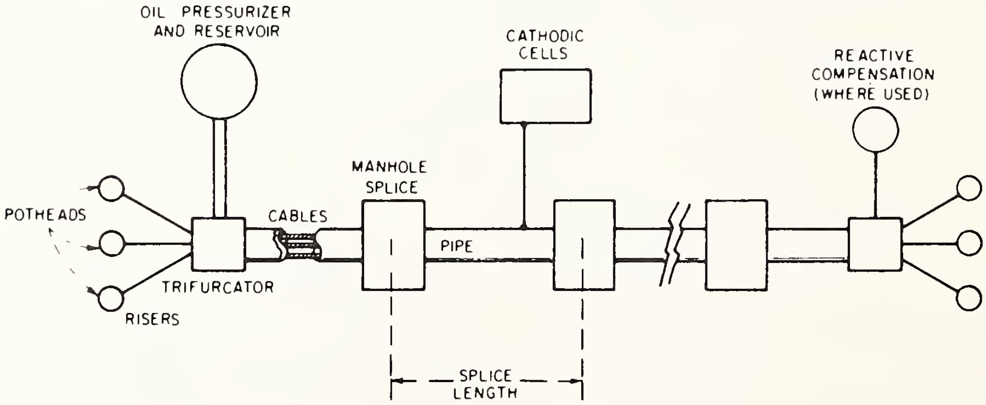
This is the oldest type of cable used for power transmission at voltages of 69 kV and above. The most common design is single conductor cable with a hollow core for oil feed. The paper insulation is covered with a lead sheath, and one of several types of protective coverings may be applied over the lead for various operating requirements.

The oil-filled system operates on the principle of complete exclusion of gas. Sealed reservoirs allow low viscosity oil to flow in and out as volume changes with operating temperatures. In low pressure cables without a reinforced sheath, normal operation is 10 to 15 psi. This pressure is insufficient to suppress ionization of entrapped gas by the electrical characteristics of the power line, and extreme care must be taken to exclude gas in manufacture, shipment, and installation. The medium pressure type oil-filled cable operating at 22 to 30 psi has an advantage because the increased oil pressure acts to inhibit the formation of gas bubbles, which would cause a breakdown of the conductor.


PAVING
THERMAL SAND BACKFILL
PETROLEUM OIL
COAL-TAR OR PLASTIC PROTECTIVE COATING
1/4" STEEL PIPE
SKID-WIRES (D-WIRES) (steel, brass, zinc etc.)
MOISTURE SEAL
CONDUCTING WRAPPING
INNER PROTECTIVE COATING
OIL IMPREGNATED KRAFT-PAPER WRAPPING
CONDUCTIVE TAPE
INSULATED-SEGMENTED COMPRESSED STRANDED CONDUCTOR

CROSS SECTION OF A SINGLE-CIRCUIT HIGH PRESSURE OIL FILLED PIPE-TYPE CABLE SYSTEM

Figure -1



COMPONENTS OF A SINGLE-CIRCUIT PIPE-TYPE CABLE SYSTEM

SOURCE: ELECTRIC RESEARCH COUNCIL

Figure -2

Extruded Solid Dielectric Cables

This type of cable is manufactured by extruding a solid dielectric insulating material, usually a polyethylene derivative, around a copper or aluminum conductor. A metallic conducting shield is then placed over the insulation, and the shield is covered with a corrosion protective jacket. The result is a sheilded single conductor cable of simple construction. The manufacturing process is continuous and the resulting cable is less expensive than other types of cables of the same voltage class and power capability. This type of cable is in common use today for lower voltage systems.

Manufacturers of solid dielectric cables recommend its use at voltages up to and including 69 kV. Extruded solid dielectric cable systems have to be installed on a restricted basis and operated at voltages through 138 kV.

Extruded solid dielectric cables using cross-linked polyethylene insulation have been subjected to accelerated life tests at the Underground Transmission Test Facility at Waltz Mill, Pennsylvania. These tests were sponsored by the Edison Electric Institute and the Electric Power Research Institute (EPRI 1974), and were conducted from 1971 to 1973. The cables tested were designed for use at voltages greater than 69 kV. All cables tested experienced some form of failure. The cable failures were in general explained, but in some cases the failing mechanism could not be identified. Additional research is being conducted by EPRI in an attempt to identify all breakdown mechanisms of cross-linked polyethylene insulated cables used at voltages greater than 69 kV.

Another type of insulating material which has been developed in recent years as an alternative to cross-linked polyethylene is ethylene propolene rubber (EPR). EPR can be spliced more easily than cross-linked polyethylene, but has not been applied at high voltages since it is still in the developmental stages.

With extruded solid dielectric cables, it is possible in certain soils to eliminate the excavation of a trench and save money by installing the cable by a plowing procedure. The mounted plow uses a rapid up-and-down oscillation to slice through the ground along its entire cutting edge like a knife. As a result, less force is required to move the blade through the soil. The resulting "slot" is clean-sided and easy to restore with less soil disturbance. As the plow blade oscillates, the cable chute maintains a constant position at the desired laying depth. The chute guides the cable into place to avoid stretching or sharp bends, thereby preventing damage to ground conditions.

Compressed Gas Insulated (CGI) Bus

This type of transmission system has been used for installations of distances on the order of hundreds of yards. The reason for the limitation is cost. For longer distances, underground high pressure oil-filled pipe type cable is less costly than CGI.

Compressed gas insulated bus offers a solution to a problem where an overhead transmission line would cross an obstacle or where a visible transmission line would be objectionable. It has been applied in cases where a new transmission line must cross an existing transmission line, and a new overhead line would require prohibitively high towers. In these cases, compressed gas insulated bus is found to be a practical solution.

This type of transmission system consists of one bus per phase. Each phase bus consists of two aluminum tubes arranged concentrically. The inner tube is the conductor, and the outer tube is an electromechanical shield. The inner conducting tube is held in place by porcelain or epoxy insulating spacers.

The conductor is an aluminum tube four to six inches in diameter, and the outer tube is an aluminum casing 14 to 16 inches in diameter. The space between the inner and outer tubes is filled with sulfur hexafluoride (SF_6) gas. The gas is maintained at a pressure of 22 psi (2.5 atmospheres absolute).

SF_6 gas is an insulating medium used in electrical equipment. It is highly stable, inert, non-toxic, non-poisonous, non-flammable, odorless, colorless, tasteless, electro-negative, and heavier than air.

Major advantages of SF_6 gas as a dielectric are its dielectric constant of 1.0 and low power factor, which makes it a low-loss insulating material. For similar voltage ratings, the charging current requirement is less than that of cable and greater than that of an overhead line.

APPENDIX C

TABLE I

NON-SALMONID FISH SPECIES KNOWN TO OCCUR IN THE STUDY AREA

Family	Species	
Scientific Name	Common Name	Scientific Name
Cyprinidae	Peamouth	*Mylocheilus caurinus*
	Northern squawfish	*Ptychocheilus oregonensis*
	Longnose dace	*Rhinichthys cataractae*
	Redside shiner	*Richardsonius balteatus*
Catastomidae	Longnose sucker	*Catastomus catastomus*
Centrarchidae	Pumpkinseed	*Lepomis gibbosus*
	Largemouth bass	*Micropterus salmoides*
Percidae	Yellow perch	*Perca flavescens*
Cottidae	Slimy sculpin	*Cottus cognatus*

APPENDIX D

APPENDIX D

Anaconda Altered Area

A. Cause of Alteration

The Anaconda area presents special problems with respect to vegetation mapping and impact assessment. Heavy metal and sulfur concentration in the air and soil, in conjunction with accelerated erosion, have severely altered both the plant communities and the former capacity of the land to support the plant communities it once did.

Taskey (1972) reviewed the historical effects of mining and smelting in the Anaconda area. This area was once wooded with Douglas fir and lodgepole pine, with some grasslands on the south-facing slopes. At present, a much larger area is dominated by herbs, while aspen, limber pine, and Rocky Mountain juniper are frequent overstory species. The area has a long history of mining-related disturbance, including the ore smelting that began in 1884 and continues at present. During this time, millions of tons of waste products have adversely affected thousands of acres of land and vegetation.

This alteration makes the productivity assessment techniques used in the rest of the study area inappropriate. A brief explanation of the alteration follows.

1. Pollutants

a. Heavy Metals[1]

Decades of air pollution in the Anaconda area have resulted in accumulation of heavy metals in the upper soil horizons (Taskey 1972, Munshower 1972); the efficacy of these pollutants has perhaps been enhanced by acid rains resulting from the smelter's SO_2 emissions. As heavy metal concentrations increase, stress to plants also increases until toxic levels are reached.

The introduction of heavy metal pollution presents a new habitat to existing plants. Increased heavy metal concentrations in the soil affects soil nutrient availability and exchange capacity, as well as mycorhial associations (Gordon 1973), which are determinants of plant diversity and coverage.

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[1] Some heavy metal effluents of the Anaconda smelter are: arsenic, antimony, copper, lead, zinc, and cadmium. For quantitative data see Taskey (1972), Munshower (1972), Hartman (1975), Peirce et al. (1913), Harkins and Swain (1907), and Haywood (1907).

As heavy metals pass from the soil to palnts, they affect various processes, usually harming the plants. Some plants exhibit metal tolerance, which can be the ability to tolerate certain concentrations of heavy metals or to evolve such tolerance. Other species seem unable to tolerate heavy metals. Possibly some plants have gene pools which possess genes for tolerance while others do not (Cragg 1971). Ecotypes[2] often exist in areas of high metal concentration. Thus heavy metals affect habitat, plant physiology, and interorganism relationships, including competition.

The severity of disruption to plants is reflected in decreasing species diversity and coverage, both of which correlate with distance from the Anaconda smelter (Taskey 1972, Munshower 1972). This is true not only for the large plants, but also for the fungi upon which vascular plants may be dependent. Soil microfungi distribution and abundance vary with heavy metal concentration, which in turn correlates with distance from the smelter and dispersal patterns. Species diversity, too, was found to decrease with increasing heavy metal concentration (Hartman 1975).

b. Sulfur Dioxide

Sulfur dioxide emission from the Anaconda smelter was about 2,300 to 2,500 tons a day in the first decades of the century (Harkins and Swain 1907, Mason 1915). Sulfur dioxide from the smelter continues, but it was reduced to 763 tons per day in 1973 (Carlson 1974b).

Conifers--which are rare in what appears to be their habitat in the altered area--are among the vascular plants most sensitive to sulfur dioxide damage. At damaging concentrations[3] sulfur dioxide harms conifers by entering the leaf through stomatal openings and dissolving in water in the mesophyll, forming highly toxic sulfite ions. Airborne sulfur has been implicated as a causal agent in damage to conifers in western Montana (Carlson 1974a), and is associated with plant damage near Anaconda (Carlson 1974b).

B. Erosion

Reduction of plant coverage due to pollutants, destructive logging, and fire has led to tremendously accelerated erosion in the altered area. Wind and water have removed much of the finer soil particles in the altered area. Raindrops falling on bare mineral soil can also force the finer particles between the larger ones, thus making the surface few millimeters relatively impervious (Daubenmire 1974). Nutrient leaching is also accelerated.

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[2] A species is typically composed of a mosaic of populations, each of which differs in genetically based physiologic (and sometimes morphologic) features having survival value, and is designated an ecotype (Daubenmire 1974). Use of this term seems justified because metal-tolerant plants may differ from normal plants in morphology and physiology as well as tolerance (Cragg 1971).

[3] Sensitivity to sulfur dioxide varies among conifers. The following species alignment (high-low sensitivity) has been suggested: subalpine fir, Douglas fir, lodgepole pine, Engelmann spruce, juniper, limber pine (Mason 1915).

Loss of plant coverage also resulted in reduction of organic matter in the soil. Loss of humus has a great effect on the nature of a parent material as a medium for plant growth (Daubermire 1974). Moreover, microclimatic extremes at the soil surface are meliarated by organic matter, and a reduction of organic matter contributes to more vigorous environment for plants.

C. Summary

Pollution and erosion have altered the vegetation of an area around Anaconda and also have affected the productive capability of the land. Habitat type and range site classifications are inappropriate because the sum of environmental factors here is not approximated elsewhere. Faulty site quality identification is likely where altered competition results in communities being located on abnormal habitats (Daubenmire 1968). Productivity assessment could be determined only by longitudinal study in the area. As a result, potential productivity of range and forested land in this area could not be predicted for impact evaluation.

D. Delineation of Altered Area

Visible damage to plants in the Anaconda area is not currently obvious as it was in the first decades following construction of the smelter. This cannot, however, be taken as an indication that either pollution or accumulation of contaminants has lessened. Gordon (1973) offers this explanation for the apparent recovery of vegetation:

> The first reason for the lesser amounts of damage today than in the period of 1900 to 1930 is that the tolerant and resistant species of plants had evolved and replaced the susceptible ones, and the second reason is that those plant species which did not have the gene pool to evolve towards more tolerant species are no longer there.

The object of delineation of the altered area near Anaconda is to assure that erroneous productivity ratings are not assigned within the area. To do this, records of visible damage from the pre-1930 era, more recent studies, and color infra-red transparencies were used.

1. Historical Data

Sixty-five years ago, visible damage to lodgepole pine extended to Silver Lake, while damage to Douglas fir ranged to Georgetown Lake (Peirce *et al*. 1910). The extent of damage to vegetation (in relation to the smelter) was then set at 19 miles north, 12 miles east, 21 miles southwest, and 19 miles west. An earlier account set the boundaries at 14 miles north, 8 miles south, and 13 miles west (Haywood 1907). Smelter fumes killed nearly all Douglas fir and lodgepole within 9 miles of the smelter, while some damage could be observed 30 miles from the smelter (mason 1915). These authors and Harkins and Swain (1907) provided data used in delineating the altered area.

2. Recent Studies

Three recent studies were of use in determining a reasonable boundary for the study area. Taskey (1972) provided information on the concentration of four heavy metals (As, Cu, Pb, Zn) in the soil at sites near Anaconda, and other data on existing vegetation. His data suggest an inverse relation between the sum of heavy metal concentrations (on a log scale) and distance from the smelter.

Munshower's work (1972) suggests an inverse relation between cadmium concentrations and distance from the smelter. Although this study concentrates on the Deer Lodge valley, his isopols were of value in suggesting the shape of the altered area.

Carlson (1974) found that sulfur dioxide injury to plants, accompanied by soil erosion, is still occurring, and that land depreciation may be long-term. Carlson (personal communication) suggested that with increasing distance from the smelter, sulfur dioxide pollution became increasingly efficacious in relation to heavy metal pollution. Carlson assisted in delineating the area where sulfur dioxide significantly affects plants.

3. Color Infra-Red Remote Sensing

Color infra-red NASA research transparencies at a scale of 1:124,000 were used in conjunction with the previously mentioned data.

When vegetation begins to die, it loses infra-red reflectance, and can be seen, contrasting to healthy vegetation, on color infra-red transparencies (National Academy of Science 1970). A change in the near infra-red region of the spectrum takes place before any change takes place in the visible portion of the spectrum (Murtha 1972).

One limitation to the use of color infra-red transparencies is that posed by the "apparent recovery" that has taken place in the years since smelting started. Nevertheless, some interesting patterns were apparent, and, in conjunction with historical data and recent studies, a reasonalbe delineation of the altered area was obtained.

APPENDIX E

TABLE I

BREEDING STATUS OF WATERFOWL SPECIES REPORTED FROM THE ANACONDA-HAMILTON STUDY AREA

Species	Status[1]
Whistling Swan (*Olor columbianus*)	M
Trumpeter Swan (*Olor buccinator*)	M
Canada Goose (*Branta canadensis*)	B
Snow Goose (*Chen caerulescens*)	M
Ross Goose (*Chen rossii*)	M
Mallard (*Anas platyrhynchos*)	B
Gadwall (*Anas strepera*)	B
Pintail (*Anas acuta*)	B
Green-winged Teal (*Anas crecca*)	B
Blue-winged Teal (*Anas discors*)	B
Cinnamon Teal (*Anas cyanoptera*)	B
American Wigeon (*Anas americana*)	B
Northern Shoveler (*Anas clypeata*)	B
Wood Duck (*Aix sponsa*)	B
Redhead (*Aythya americana*)	B
Ring-necked Duck (*Aythya collaris*)	M
Canvasback (*Aythya valisineria*)	B
Lesser Scaup (*Aythya affinis*)	B
Common Goldeneye (*Bucephala clangula*)	B
Barrow's Goldeneye (*Bucephala islandica*)	M
Bufflehead (*Bucephala albeola*)	M
Harlequin Duck (*Histrionicus histrionicus*)	B
Ruddy Duck (*Oxyura jamaicensis*)	B
Hooded Merganser (*Lophodytes cucullatus*)	B
Common Merganser (*Mergus merganser*)	B
Red-breasted Merganser (*Mergus serrator*)	M

SOURCE: Skaar 1975; Flath 1970.

[1] B = breeding, M = migrant or wintering only (Latilongs 25 and 26).

TABLE II

RATING SCALE USED IN DETERMINING RELATIVE IMPORTANCE OF SPECIES OF CONCERN

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1. Value Component

A. Relative Resource Value

Game Animals. The relative resource value (V_1) of a given game species = $(B/B_{max}) \times 5$ (rounded to the nearest non-zero integer), where B = estimated biomass of local harvest of that species during the most recent hunting season, and B_{max} = the greatest value of B received by any of the game species found in the area.

Furbearers. The relative resource value (V_1) of a given fur-bearing species = $(H/H_{max}) \times 2$ (rounded to the nearest non-zero integer), where H = estimated dollar value of local harvest of that species during the most recent season, and H_{max} = the greatest value of H received by any one of the furbearers found in the area.

All Other Species. The relative resource value (V_1) of all other species = 0.

B. Relative Recreational Value

Game Animals. The relative recreational value (V_2) of a given game species = $(D/D_{max}) \times 5$ (rounded to the nearest non-zero integer), where D = estimated hunter days spent locally in pursuit of that species during the most recent hunting season, and D_{max} = the greatest value of D received by any of the game species found in the area.

All Other Species. The relative recreational value (V_2) of all other species = 0.

C. Relative Scientific Value, (V_3)

Species or subspecies endemic to the area	5
Relict population essentially restricted to the area	2
Other populations of unusual scientific interest	1

2. Vulnerability Component

A. Status, (V_4)

Endangered	10
Threatened	5
Status Undetermined	1

Table II, continued

B. Worldwide Abundance, (V_5)

Less than 100 individuals	16
101-1000 individuals	8
1001 - 10,000 individuals	4
10,001 - 100,000 individuals	2

C. Reproductive Potential, (V_6)

Low (maximum number of offspring potentially produced in five years beginning with one newborn pair from one to ten)	1
Very Low (maximum number of offspring potentially produced in five years beginning with one newborn pair less than one)	2

D. Restriction of Distribution

Study area contains 1-10% of worldwide population	3
Study area contains 10-100% of worldwide population	10

RATING SCALE USED IN ASSESSING SEVERITY OF WORST POTENTIAL IMPACTS

No significant effect on population levels	0
Possibility of significant short-term displacement	1
Possibility of significant short-term increase in mortality rates	2
Possibility of significant short-term decrease in carrying capacity	3
Possibility of significant long-term increases in mortality rates	7
Possibility of significant long-term decreases in carrying capacity	10
Possible elimination of populations from study area	25

TABLE III

RATING SCALE FOR ASSIGNING WILDLIFE HABITAT SUITABILITY VALUES TO HABITAT CATEGORIES

ting	Suitability	Definition	Characteristics			Examples		
			Preferred?	Necessary?	Fulfills all requirements?	Species	Season	Category
0	No Use	Receives very little or no use under normal circumstances	No	No	No	Mountain Goat	Winter	Cottonwood
1	Marginal	Used only when other types not available or during movement between preferred types; relative use generally less than relative extent of type	No	No	Possibly	Lynx	Summer	Agricultural
2	Adequate	Used when encountered but not actively sought or preferred over other types. Relative use roughly proportional to relative extent of type	No	No	Possibly	Elk	Summer	Lodgepole Pine
3	Preferred	Preferred over other types when available; relative use greater than relative extent of type	Yes	No	Possibly	White-tailed deer	Spring	Cottonwood
4	Limiting or Essential	Adequately fulfills an essential requirement of the species which is met by no other type; removal of this type may drastically reduce or eliminate populations. Relative use may or may not be greater than relative extent of type. Includes types used exclusively	Possibly	Yes	Possibly	Moose	Winter	Willow Bottoms

TABLE IV

		HABITAT CATEGORY														
		Man-Altered	Large Water Areas	Agricultural	Bunchgrass	Cottonwood	Timber/Bunchgrass	PP-DF/Shrub	DF/Grass and Forb	Lodgepole Pine	AF-GF Dry	AF-GF Moist	Subalpine and Timberline	Scree and Rock	Willow and Alder Flats	Logged
Taxon	Season[1/]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Waterfowl	Spring-Fall	0	3	3	1	4	0	0	0	0	0	0	0	0	0	0
Black Bear	Yearlong	0	0	0	0	0	1	2	2	2	2	2	2	2	2	1
Marten	Yearlong	0	0	0	0	0	1	2	2	2	2	2	2	2	1	1
Fisher	Yearlong	0	0	0	0	0	1	2	2	2	2	2	2	2	2	1
Wolverine	Yearlong	0	0	0	0	0	1	1	2	2	2	2	2	2	1	1
Mountain Lion	Yearlong	0	0	1	1	0	2	2	2	2	2	2	2	2	1	2
Elk	S-F	0	0	0	1	0	1	1	2	2	2	3	2	1	2	1
	W-S	0	0	1	2	0	3	3	2	1	1	1	0	0	1	1
	Yearlong	0	0	1	2	0	3	3	2	2	2	3	2	1	2	1
Mule Deer	S-F	0	0	1	2	2	2	3	3	2	2	2	2	1	2	2
	W-S	0	0	2	3	1	3	3	3	1	1	1	0	0	1	1
	Yearlong	0	0	2	3	2	3	3	3	2	2	2	2	1	2	2

Table IV, continued

		HABITAT CATEGORY														
Taxon	Season[1]	Man-Altered 1	Large Water Areas 2	Agricultural 3	Bunchgrass 4	Cottonwood 5	Timber/Bunchgrass 6	PP-DF/Shrub 7	DF/Grass and Forb 8	Lodgepole Pine 9	AF-GF Dry 10	AF-GF Moist 11	Subalpine and Timberline 12	Scree and Rock 13	Willow and Alder Flats 14	Logged 15
White-tailed Deer	S-F	0	0	2	2	3	2	3	2	0	0	0	0	0	2	1
	W-S	0	0	3	2	2	2	2	1	0	0	0	0	0	1	1
	Yearlong	0	0	3	2	3	2	3	2	0	0	0	0	0	2	1
Moose	S-F	0	1	0	0	0	1	2	2	2	2	2	2	0	3	1
	W-S	0	0	0	0	0	1	3	2	2	2	1	0	0	4	1
	Yearlong	0	1	0	0	0	1	3	2	2	2	2	2	0	4	1
Mountain Goat	S-F	0	0	0	0	0	1	2	2	2	2	2	3	3	0	1
	W-S	0	0	0	0	0	1	1	1	1	1	1	3	3	0	1
	Yearlong	0	0	0	0	0	1	2	2	2	2	2	3	3	0	1
Bighorn Sheep	S-F	0	0	0	2	0	3	2	2	2	2	2	2	3	0	1
	W-S	0	0	0	2	0	3	1	2	0	0	0	0	3	0	0
	Yearlong	0	0	0	2	0	3	2	2	2	2	2	2	3	0	1

[1] S-F = Summer-Fall; W-S = Winter-Spring

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Many helpful suggestions from the DNR Director's Special Staff were incorporated into this report

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August 5, 1976

In my cover letter of July 30, I indicated that two additional maps relating to the Anaconda-Hamilton 161 kV Transmission Line Draft EIS would be sent under separate cover. Enclosed herein are those maps, entitled "Slope" and Existing Land Use--Site Patterns." Please insert them into the map pocket on the back cover of the Draft.

Thank you.

Sincerely,

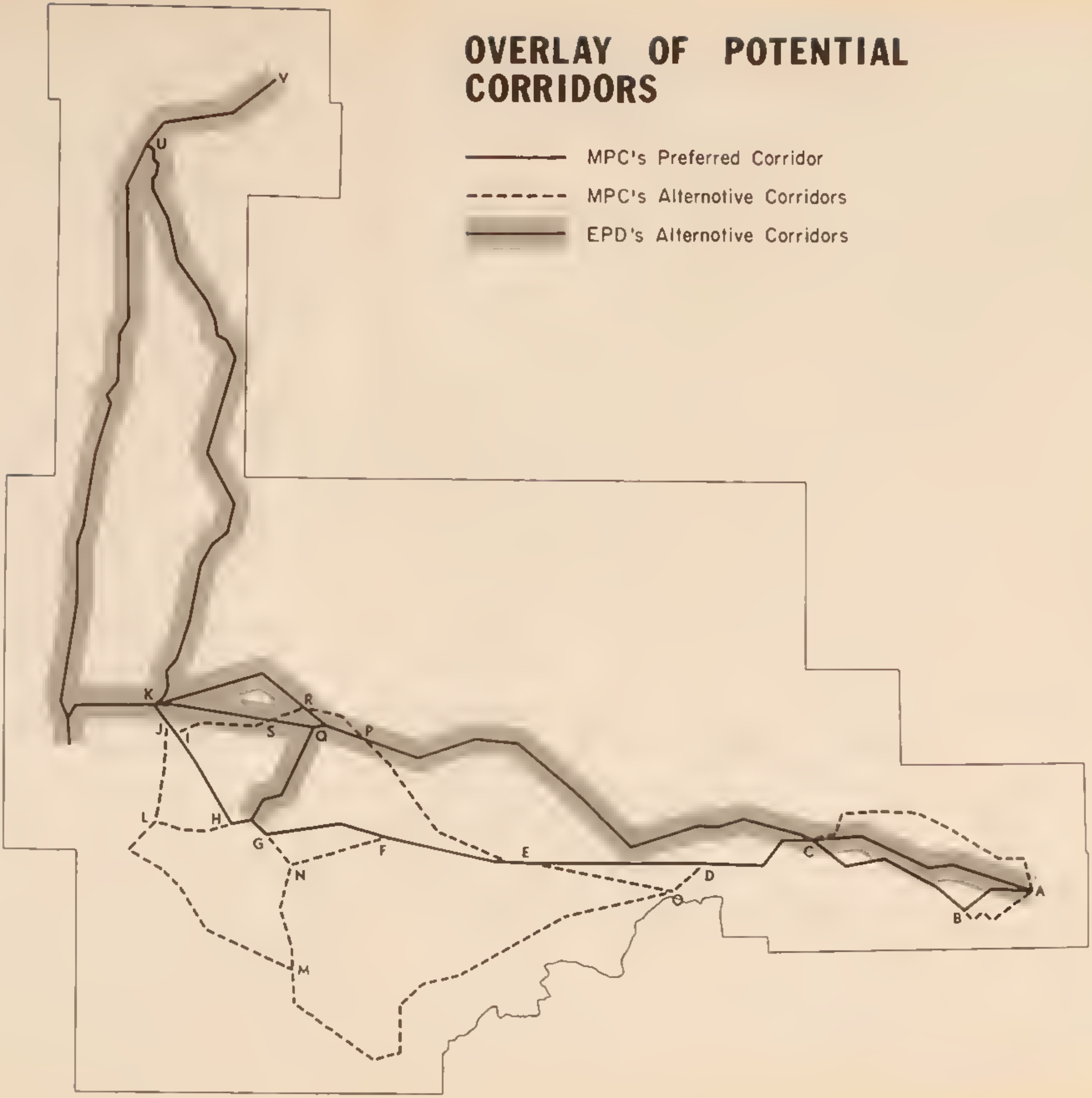
Wayne Wetzel

WAYNE WETZEL
ENVIRONMENTAL COORDINATOR

WW/ad

Enclosure

OVERLAY OF POTENTIAL CORRIDORS



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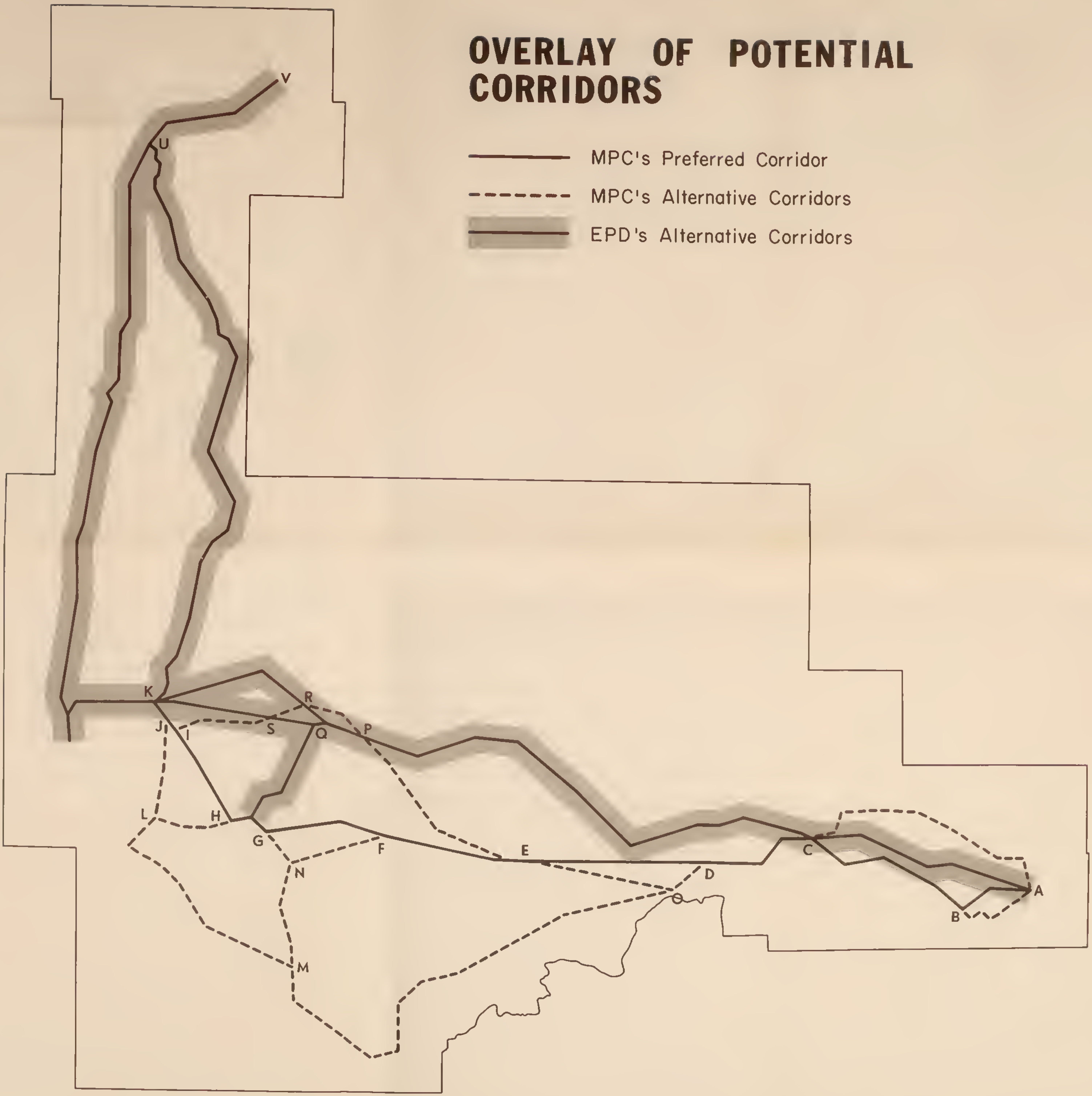
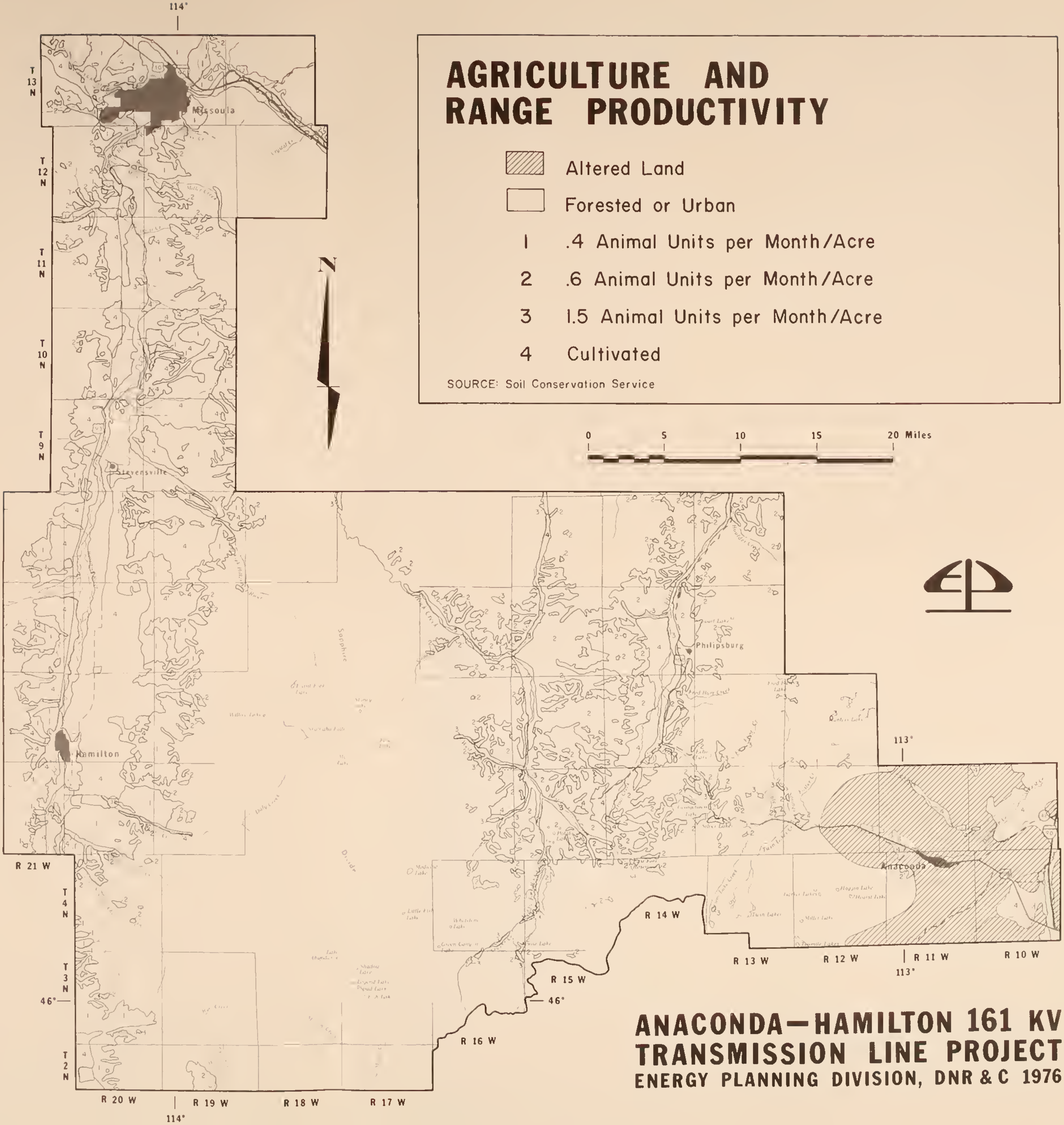




AGRICULTURE AND RANGE PRODUCTIVITY

▨ Altered Land

☐ Forested or Urban

1 .4 Animal Units per Month/Acre

2 .6 Animal Units per Month/Acre

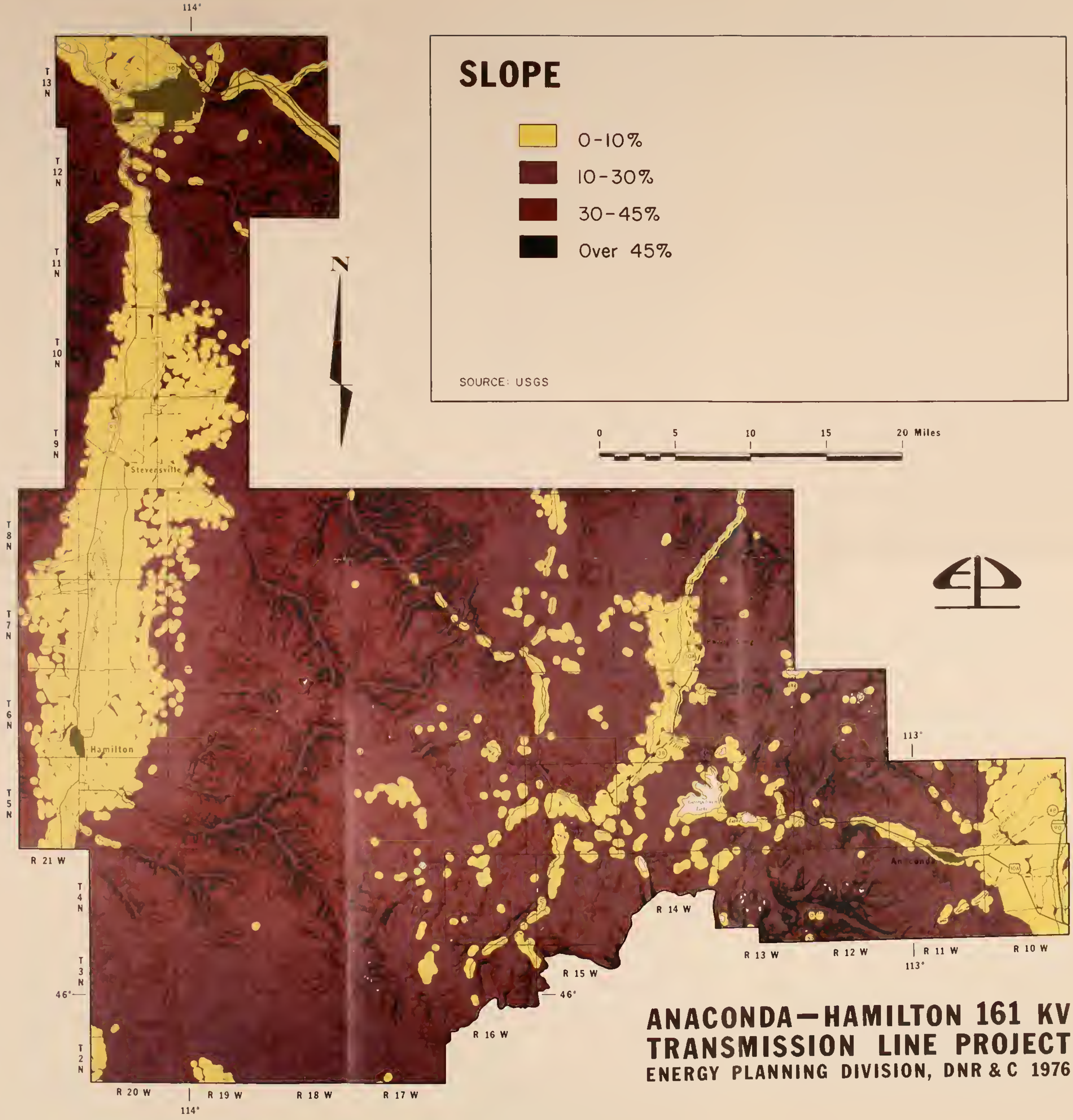
3 1.5 Animal Units per Month/Acre

4 Cultivated

SOURCE: Soil Conservation Service

ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976



SLOPE

- 🟨 0-10%
- 🟫 10-30%
- 🟥 30-45%
- ⬛ Over 45%

SOURCE: USGS

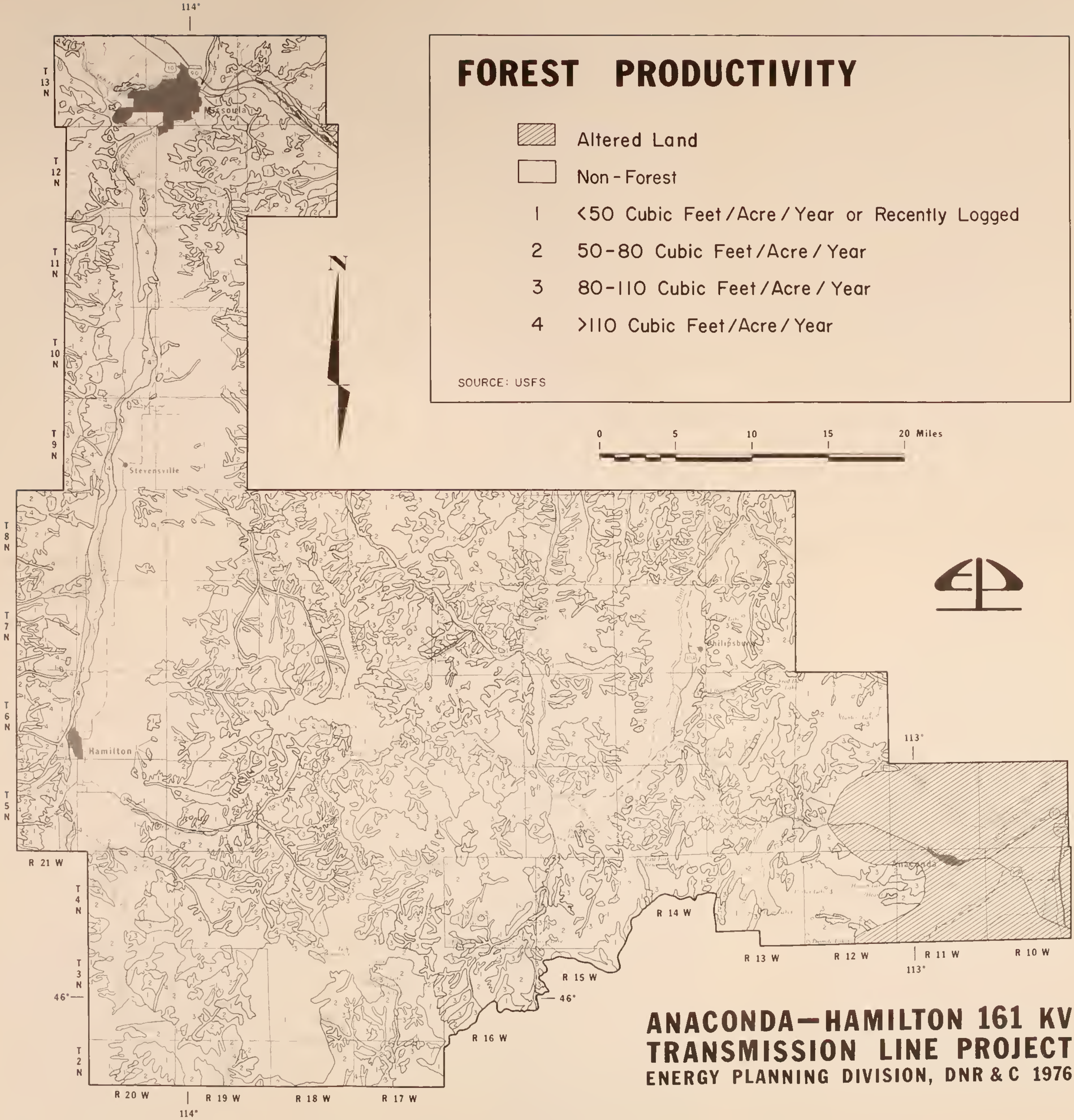
ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

ENERGY PLANNING DIVISION, DNR & C 1976

FOREST PRODUCTIVITY

▨ Altered Land
☐ Non-Forest
1 <50 Cubic Feet/Acre/Year or Recently Logged
2 50-80 Cubic Feet/Acre/Year
3 80-110 Cubic Feet/Acre/Year
4 >110 Cubic Feet/Acre/Year

SOURCE: USFS



ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT

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EXISTING LAND USE
SITE PATTERNS

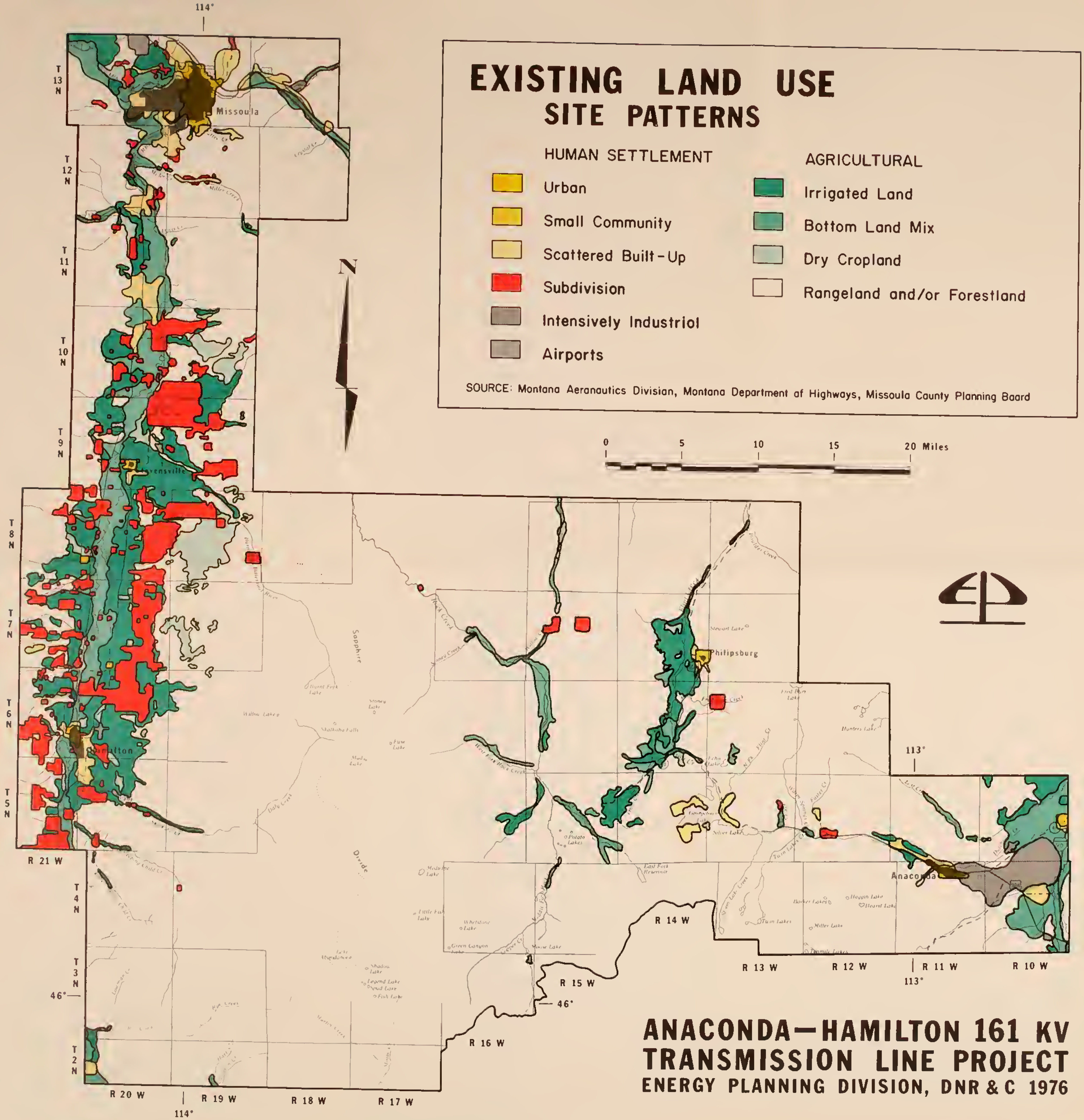
HUMAN SETTLEMENT

- 🟨 Urban
- 🟨 Small Community
- 🟨 Scattered Built-Up
- 🟥 Subdivision
- ⬛ Intensively Industrial
- ⬛ Airports

AGRICULTURAL

- 🟩 Irrigated Land
- 🟩 Bottom Land Mix
- 🟩 Dry Cropland
- ⬜ Rangeland and/or Forestland

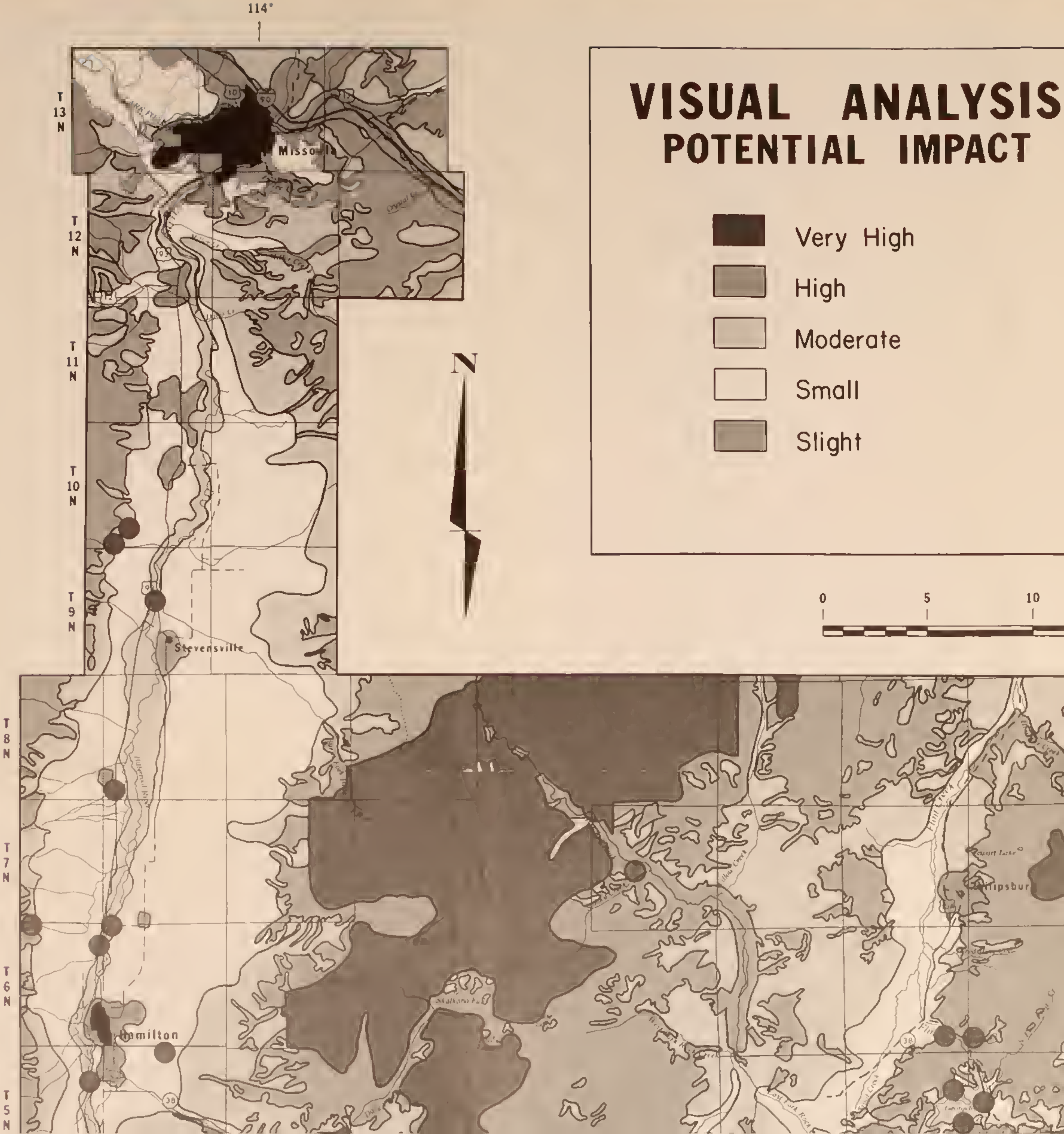
SOURCE: Montana Aeronautics Division, Montana Department of Highways, Missoula County Planning Board

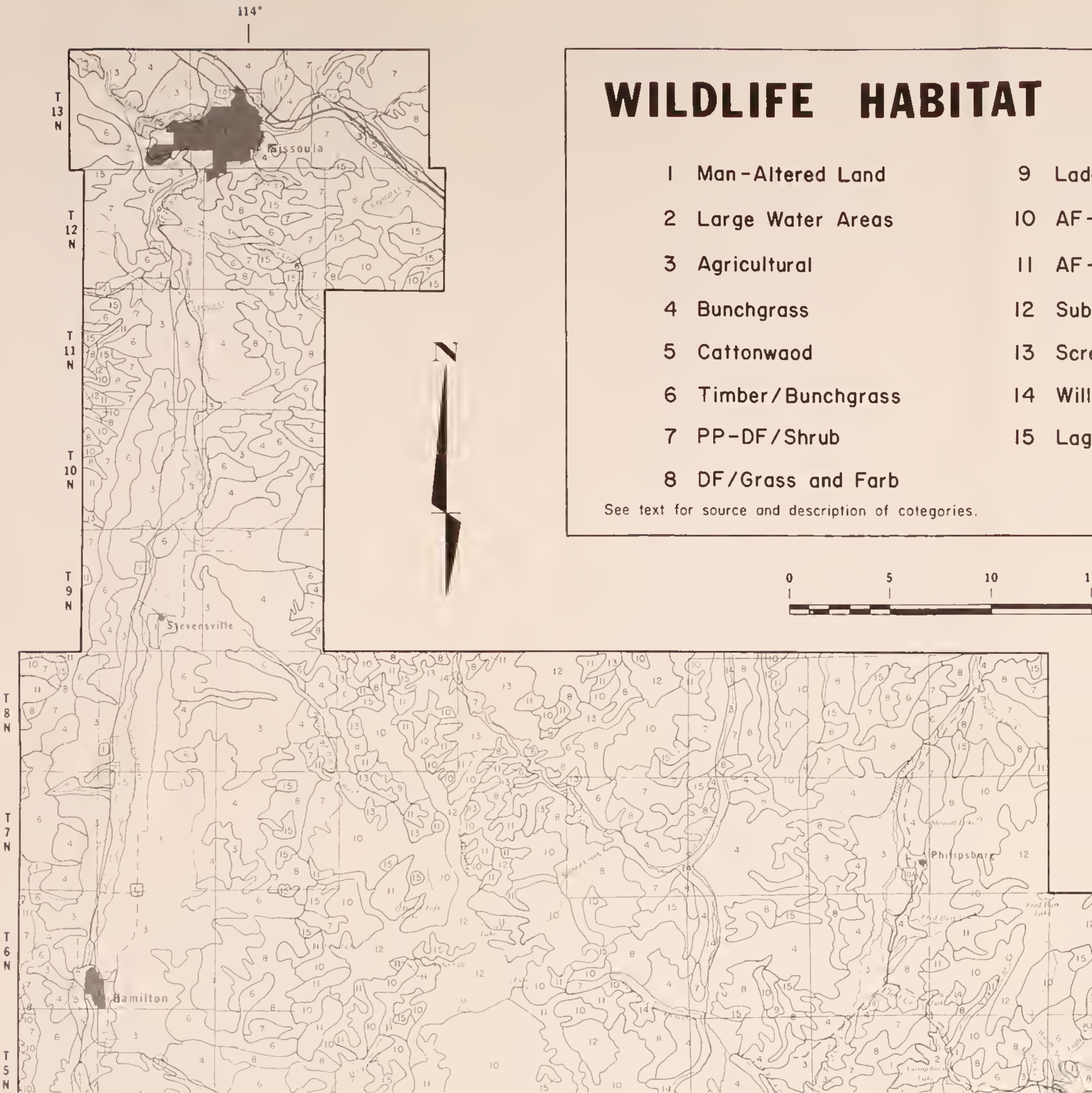


ANACONDA—HAMILTON 161 KV TRANSMISSION LINE PROJECT
ENERGY PLANNING DIVISION, DNR & C 1976

VISUAL ANALYSIS
POTENTIAL IMPACT

- ■ Very High
- ▩ High
- ▨ Moderate
- ☐ Small
- ▧ Slight





WILDLIFE HABITAT

1	Man-Altered Land	9	Lad
2	Large Water Areas	10	AF-
3	Agricultural	11	AF-
4	Bunchgrass	12	Sub
5	Cottonwood	13	Scr
6	Timber/Bunchgrass	14	Will
7	PP-DF/Shrub	15	Lag
8	DF/Grass and Forb		

See text for source and description of categories.

3

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